

EXHIBIT 3

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF DELAWARE

CALLAWAY GOLF COMPANY,

Plaintiff,

v.

C. A. No. 06-91 (SLR)

ACUSHNET COMPANY,

Defendant.

EXPERT REPORT OF WILLIAM M. RISEN, JR.

I. PERSONAL BACKGROUND

1. I am a Professor of Chemistry at Brown University. I have been retained by Callaway Golf as a consultant and expert witness in this case.
2. I have worked in the areas of ionomers, polyurethanes, molecular spectroscopy, organometallic chemistry, physical-inorganic chemistry, aerogels, quantized ion motion in condensed phases, and solid state chemistry. Based on my experience and education, I believe I am an expert in the chemistry and materials science of polymers and other amorphous materials.
3. I have been employed as a research and development consultant in the golf ball industry, in various capacities, for about 20 years. Based on this experience, I believe I possess expertise in the field of golf ball design.
4. I graduated from Georgetown University in 1962 with a B.S. in chemistry. I earned a Ph.D. in chemistry from Purdue University in 1967. I was a Research Fellow-Instructor at Brown University in 1966-1967. I was an Assistant Professor of Chemistry at Brown University 1967 to 1972. I was an Associate Professor of Chemistry at Brown University from 1972 to 1975. I have been a Professor of Chemistry at Brown University since 1975. From 1972 to 1980 I served as the chairman of the Department of Chemistry at Brown University.
5. I received a Foreign Invitational Fellowship from the Japan Society for the Promotion of Science for 2002-2003.
6. I was a Visiting Professor at McGill University in Montreal, Canada in 1991-1992.
7. In 1998, I was a Visiting Scientist at the Paul Scherrer Institute of ETH-Zurich and the Swiss Federal Science Foundation.

8. I am the author of over 100 publications and am named as an inventor on 37 United States patents, including 18 golf ball patents. A copy of my curriculum vitae is attached as Appendix A.

9. I have not testified as an expert witness within the last four years.

10. I am being compensated for the time I spend on this litigation at my standard rate of \$270 per hour.

II. SUMMARY OF WORK PERFORMED AND OPINIONS

11. I understand that, in this litigation, Callaway Golf has asserted that the Titleist Pro V1 family of golf balls, manufactured and sold by Acushnet, infringes various claims of the following four United States patents owned by Callaway Golf:

- U.S. Patent No. 6,210,293 ("the '293 patent")
Claims: 1, 2, 4, and 5;
- U.S. Patent No. 6,503,156 ("the '156 patent")
Claims: 1-11;
- U.S. Patent No. 6,506,130 ("the '130 patent")
Claims 1, 2, 4, and 5;
- U.S. Patent No. 6,595,873 ("the '873 patent")
Claims 1 and 3.

12. I also understand that Acushnet alleges that these patent claims are invalid in light of various prior art references. Acushnet has submitted an Expert Report of Dr. William J. MacKnight and an Expert Report of Dr. Robert J. Statz addressing validity.

13. I have been asked for my expert opinion regarding the validity of those patent claims in light of the prior art presented by Acushnet and, in particular, for my expert opinion regarding the analysis and conclusions of Dr. MacKnight and Dr. Statz.

14. As explained in detail below, it is my opinion that all of the asserted claims of the four patents listed above are valid over the prior art relied upon by Dr. MacKnight and Dr. Statz. In particular, I do not believe any of the asserted claims is anticipated by the prior art, nor do I believe that the invention described in any asserted claim would have been obvious to one of ordinary skill in the art at the time the invention was made.

15. Additionally, it is my opinion that Acushnet's U.S. Patent No. 5,885,172 includes claims to a urethane-over-ionomer multi-layer golf ball essentially the same as that claimed in the patents-in-suit. Acushnet's invalidity arguments, if accepted as evidence that the asserted claims are invalid, would also establish the invalidity of at least two claims of its own '172 patent.

16. In preparing this report, I have reviewed and/or relied upon portions of the materials listed in Appendix B.

III. TERMS USED IN THIS REPORT

17. In this report, I will use the term "Pro V1" to refer to the entire family of Titleist Pro V1 golf balls, including each and every version of the Titleist Pro V1, Titleist Pro V1x, and Titleist Pro V1 Star. In places where I mean to refer to one of those balls but not the others, I will say so.

18. I will use the terms "Spalding" and "Top-Flite" interchangeably to refer to the golf ball business that, until its acquisition by Callaway Golf in 2003, was owned by various corporate incarnations of the Spalding & Evenflo Co., Spalding Sports Worldwide, Inc., and Top-Flite Golf Co.

19. I will use the terms "inner cover layer" and "mantle layer" interchangeably.

20. Where I refer to a "Shore D hardness," I mean a measurement taken "on the ball" (that is, on the surface of the inner or outer cover layer), rather than a measurement taken of a material formed in a plaque. Where I mean to discuss the Shore D measurement taken of a material in plaque form, I will specifically refer to it as a "plaque" hardness.

IV. INTRODUCTORY REMARKS

21. As an introduction to this report, I offer the following general remarks, any or all of which I may include in my testimony at trial.

22. Ultimately, this case comes down to whether Michael Sullivan's invention was obvious. Since many practitioners had the motivation and were working hard to invent a superior golf ball, we don't have to guess what might have been or could have been obvious. We already know the answer because the industry went through the experience. The experience was that it was not obvious to James Proudfit, who did not include polyurethane in his multi-layer golf ball. It was not obvious to Shenshen Wu, who did not think to apply her polyurethane cover over an inner cover layer in a three-piece ball. It was not obvious to Robert Molitor, Terry Melvin, and their co-inventors, even though they were located in the same lab as Dennis Nesbitt, since they spent years on a difficult attempt to make an ionomer-urethane blend work on two-piece balls.

23. Clearly, every designer at a major golf ball company was trying to solve the same problem, but none of them did. They missed the key inventive step; Sullivan discovered it. In my opinion, it is not fundamentally a question of what would have been obvious; we know the answer to that because we lived through the experiment. The simple fact is that Sullivan's invention was not obvious to those who worked in the field.

V. LEGAL PRINCIPLES

A. ANTICIPATION

24. I am advised that, in order to find a patent claim to be invalid for "anticipation" under 35 U.S.C. section 102, each and every element of that claim, as properly construed, must be found either explicitly or inherently in a single prior art reference.

25. I am further advised that an element can be said to be inherently found in a prior art reference only if clear and convincing evidence shows that the missing subject matter is necessarily present in the thing described in the reference, and only if the missing subject matter would be so recognized by persons of ordinary skill in the relevant art. Inherency may not be established by probabilities or possibilities, and the mere fact that a certain thing may result from a given set of circumstances is not sufficient. In other words, in order for a claimed element to be inherent in a reference, one of skill in the art must understand that the element is present as a matter of technical necessity in the context of the reference, not that the limitation could or might be present, for example, as a choice of the designer.

26. I am advised that a single prior art reference that discloses, either explicitly or inherently, each and every element of a claim is said to "anticipate" that claim, and that such a claim is said to be "anticipated."

27. I have also been advised that, in order to anticipate a patent claim, a prior art reference must not only disclose all of the limitations of the claim, but also must be "enabling." Such a reference is "enabling" when its disclosures are sufficient to allow one of ordinary skill in the art to make and use the claimed invention without an "undue amount of experimentation."

B. OBVIOUSNESS

28. I have been advised that a claim is invalid as "obvious" under 35 U.S.C. section 103 only if the differences between the claim and the prior art are such that the subject matter of the claim as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art.

29. I have further been advised that, in assessing obviousness, factors to be considered include the scope and content of the prior art, the differences between the prior art and the claimed invention being considered, and the level of skill of a person of ordinary skill in the art.

30. I am advised that a claim can be obvious in view of a single prior art reference, or by the combination of two or more prior art references. I understand that, for a claim to be obvious, the single reference, or the combination of references, must expressly or inherently disclose each and every limitation of the claim, or render the claim obvious as a whole. I also understand that a patent composed of several elements is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art.

31. I am advised that, when making an obviousness determination, one must guard against the use of hindsight. In other words, one must be aware of the distortion caused by hindsight bias, and must be cautious to avoid reading into the prior art the teachings of the claimed invention in issue.

32. Additionally, I am advised that the fact that a combination was "obvious to try" might show that a patent claim was obvious, but only if the problem to be solved is one for which: (1) there exists a finite number of identified, predictable solutions, (2) a person of ordinary skill has good reason to pursue the known options within his or her technical grasp, and (3) pursuing these

known options leads to an anticipated success that is likely the product not of innovation but of ordinary skill and common sense.

33. I have also been advised that an analysis of "secondary considerations of non-obviousness" is also relevant to the determination of whether a claim is obvious, and that such considerations may be used to rebut a defense of obviousness even when combinations of the prior art disclose all the elements of the claim. Such an analysis may consider, for example, whether the invention fills a long-felt but unsolved need, the failure of others to arrive at the invention, commercial success attributable to the claimed invention, near-simultaneous invention by others, evidence of copying of the claimed invention by competitors, industry acquiescence, initial skepticism, and praise of the invention by others.

34. Finally, I am advised that, in making an obviousness determination, it is important to consider whether the prior art reference or references to be relied upon "teach away" from combining the references to achieve the claimed invention.

VI. CLAIM CONSTRUCTION

A. "SHORE D HARDNESS"

35. I have been advised that Acushnet and Callaway Golf disagree as to whether the phrase "Shore D hardness," as it is used in the asserted claims, refers to a hardness measurement taken on the surface of the inner or outer cover layer, or on a "plaque" prepared in accordance with ASTM D-2240. (Statz Report ¶ 56.)

36. I believe that Callaway Golf's proposed interpretation – that "Shore D hardness" be construed to refer to hardness measurements taken directly on the surface of the inner or outer cover layer – is appropriate.

37. In each of the asserted claims, the claim language refers to "an inner cover layer having a Shore D hardness ..." and "an outer cover layer having a Shore D hardness" Given this wording, I believe the claims unambiguously state that the "Shore D hardness" refers to the inner and outer cover layers themselves, that is, as those cover layers exist on the ball.

38. Under Acushnet's proposed interpretation, "Shore D hardness" would refer to "a plaque of material that conforms to the ASTM D-2240 standard." (Statz Report ¶ 57.) Such a plaque, however, would not be an "inner cover" or "outer cover." The claim language does not refer to the Shore D hardness of the *material* comprising the inner cover layer or outer cover layer; it refers to the Shore D of the "inner cover" and "outer cover" themselves. Therefore, I believe Acushnet's interpretation conflicts with the plain meaning of the claim language.

39. I have been informed that where, as here, a claim term is unambiguous, it is not necessary to seek clarification or definition of that term from the patent specification. However, if one were to do so with respect to the claim term "Shore D hardness," the specification of the patents-in-suit supports the conclusion that the claims refer to an "on-the-ball" measurement:

- Table 5 lists Shore C measurements for "intermediate balls" (e.g. '293 patent col. 17:25);
- Tables 6A and 6B list Shore C measurements for finished balls;
- Table 7, listing Shore D measurements for finished balls;
- Table 8 lists Shore D measurements for finished balls;
- Table 9 lists Shore C measurements for finished balls (see, e.g., '293 col. 22:66, referring to "properties of finished balls").

40. Given these disclosures, I believe that the specification, read as a whole, favors the interpretation that "Shore D hardness" refers to a measurement taken "on the ball," particularly since the claim language itself is clear.

41. Dr. Statz arrives at his conclusion that Shore D hardness must be measured on a plaque based in part on the statement in the specification that "Shore hardness was measured in accordance with ASTM test 2240." (E.g., '293 patent, col. 16:49-50 and Statz Report ¶ 60.)

42. I disagree that the statement that "Shore hardness was measured in accordance with ASTM test 2240" compels the interpretation that the claimed "Shore D hardness" requires a "plaque" measurement rather than an on-the-ball measurement. (See Statz Report ¶ 60.)

43. ASTM D-2240 refers, generally, to procedures for taking hardness measurements using Shore durometers, including the calibration of the durometer (D-2240 section 7), the conditioning of the sample (section 8) and the application of the durometer to the sample (section 9).

44. Although D-2240 section 6 specifies that a measurement made in strict conformance with the D-2240 standard be made on a "plaque" of material, a Shore D durometer can be used to obtain a reading of Shore D hardness on samples that have other sizes and shapes than those specified in ASTM D-2240.

45. In my experience, it is common among golf ball manufacturers to obtain measurements of Shore D hardness by applying the durometer directly to the curved surface of the finished or unfinished ball. For example, Dr. Statz, in his U.S. Patent No. 6,100,340, confirms that the cover hardnesses of certain finished golf balls were "obtained using a Shore D durometer." ('340 patent col. 9:49-52.)

46. Moreover, given the context of the statement Dr. Statz cites from the specification, that statement actually compels the interpretation that "Shore D hardness" in the claims refers to a measurement made on the ball. The statement cited by Dr. Statz appears in the discussion of "Example 1" in the specification. In that same discussion, just a dozen lines earlier, the specification explains that the Shore hardness was measured on the "molded intermediate ball." The specification states: "The resulting molded intermediate balls were tested to determine the individual compression (Riehle), C.O.R., Shore C hardness, spin rate and cut resistance properties." (See '293 Patent, col. 16:34-37 (emphasis added).) Once the intermediate ball (the ball missing the outer cover layer) has been molded, the only way to measure the Shore hardness

is on the ball itself. Accordingly, one of skill in the art could only understand this statement to mean that the Shore hardness was measured on the ball.

47. The statement upon which Dr. Statz relies then appears a few lines later: "Shore hardness was measured in accordance with ASTM test 2240." (See '293 Patent, col. 16:49-50.) Considering that the earlier statement clearly indicates that the Shore hardness was measured on the intermediate ball (and not on a plaque), this statement must refer to aspects of the ASTM test relating to the calibration of the durometer and the position of the sample. Reading the statement to require a measurement on the plaque would make it inconsistent with the earlier portion of the specification.

48. Dr. Statz has suggested that "when the patents-in-suit refer to material properties of the 'inner cover layer' or 'outer cover layer,' they are clearly referring to properties of the materials that make up the cover layer." (Statz Report ¶ 58.) I disagree.

49. As noted above, the claim language "an inner cover layer having a Shore D hardness" and "an outer cover layer having a Shore D hardness" is unambiguous – the hardness plainly refers to the inner or outer cover layer. This language does not refer, expressly or implicitly, to "the materials that make up the cover layer," as Dr. Statz asserts. (Statz Report ¶ 58.)

50. Dr. Statz notes that some claims of the patents refer to "an outer cover layer having a modulus in a range of about 1,000 to about 30,000 psi." (Statz Report ¶ 58.) I am informed that Callaway Golf is not asserting these claims in this litigation, and that they therefore are not subject to construction. But assuming, for the sake of argument, that Dr. Statz is correct that a flex modulus measurement cannot be taken on a golf ball cover, a Shore D hardness measurement certainly can be. I therefore do not consider the term "Shore D hardness," as it is used the asserted claims, in any way ambiguous.

51. Dr. Statz has noted that, in other patents related to the patents-in-suit, "Shore D hardness" is more specifically claimed as Shore D hardness "measured on the curved surface" of the cover layer. (Statz Report ¶ 59.) Dr. Statz states that, "when Mr. Sullivan or Spalding wanted to claim the Shore D hardness as measured on the ball, it explicitly so stated." I observe, however, that by the same argument, if Mr. Sullivan or Spalding had wanted the claim term "Shore D hardness" to refer to the hardness of an ASTM D-2240 plaque, the claim could have been written to refer to such a plaque specifically.

B. "CORE"

52. I understand that Acushnet will ask the Court to construe "core" to mean "the singular component of the golf ball that occupies the geometric center of the golf ball." In my opinion, this construction is neither necessary nor justifiable.

53. The term "core," as used in the claims, has an ordinary and plain meaning, and the specification of the patents-in-suit does not suggest any special definition of the term. Therefore, I believe the term "core" needs no further interpretation. However, should the Court wish to explore the matter further, I offer the following comments.

54. There is no generally understood requirement that a "core" must be a "singular" piece of material, as Acushnet suggests. In the golf ball industry, there is a common understanding that a ball can have a "dual core" or "multi-layer core." A dual core is, of course, a core. Under Acushnet's interpretation, however, there would be no such thing as a "dual core," since only the inner core layer would be the "core." This interpretation, if adopted, would conflict with the common understanding in the industry that a core may have more than a single component.

55. For example, the words "Soft Dual Core" are prominently featured on the packaging of the Titleist Pro V1x golf balls. (AC117479.)

56. Also, I have read a sworn declaration from Jerry Bellis, Acushnet's VP of Titleist Sales and Marketing, in which he describes the 2000 Titleist HP Eclipse ball as having "advanced dual core technology." (Bellis ¶ 39.)

57. Similarly, Dr. Statz holds at least two patents that confirm that a "core" may have multiple layers:

A "cover" or a "core" as these terms are used herein may be formed from a single layer or from two or more layers, and, thus, may comprise a plurality of layers. ... A core, whether formed from a single layer or from two or more layers, may serve as a center for a wound ball.

(U.S. Patent No. 5,971,869 col. 4:12-19.)

Multilayer balls can have a variety of constructions, such as having multiple core layers

(U.S. Patent No. 6,100,340 col. 1:32-33.)

VII. OPINIONS REGARDING VALIDITY

A. DEFINING "A PERSON OF ORDINARY SKILL IN THE ART"

58. I believe that, at the relevant time, "a person of ordinary skill in the art," as that term relates to the patents-in-suit, would have possessed at least one year of experience in the design and manufacture of golf balls.*

59. Dr. Statz describes "one of ordinary skill in the art" as follows:

[I]n 1995, a person of ordinary skill in the art of the invention of the patents-in-suit had a number of years of experience in golf ball design and/or golf ball cover design. A person of ordinary skill in the art would

* I understand that the parties dispute the effective filing date of the patents-in-suit, and that Acushnet claims that the earliest filing date the patents-in-suit are entitled to is 1995. I have no opinion on this issue, and I acknowledge it here only to note that whether the effective filing date is 1993 or 1995 has no effect on any of my opinions.

have a general understanding of the types of golf ball materials and constructions that had been used in the golf ball industry up to that point in time. A person of ordinary skill in the art would be aware of prior art golf ball construction patents.

(Statz ¶ 49.)

60. I disagree with Dr. Statz's characterization for the following reasons:

- I believe a person of ordinary skill in the art would not necessarily know the constructions and compositions used in any particular golf ball, since that information is not always apparent or easily figured out. Also, I do not think a person of ordinary skill in the art would necessarily recognize that any particular patent was embodied in any particular golf ball.
- Additionally, I doubt that any person is familiar with all of the hundreds of prior-art golf ball construction patents.

B. HARDNESS IS NOT AN INHERENT PROPERTY OF A POLYMER COMPOSITION, AND WOULD NOT HAVE BEEN RECOGNIZED AS SUCH

61. Dr. Statz's arguments of anticipation and obvious rely, in many places, on the assumption that even if a prior art reference does not disclose a Shore D hardness for an inner or outer cover layer, the disclosure of that hardness is "inherent" in the reference. I do not believe that, under my understanding of the legal principle of inherency, that Dr. Statz's assumption is correct. My understanding is that for a property to be "inherent" in a prior art reference, whatever is disclosed by the reference must inevitably and necessarily possess that property, and that inherency cannot be shown by "possibilities or probabilities."

62. Hardness is not a fundamental, inherent property of a polymer composition, by which I mean that it is not a property that remains unchanged regardless of the size, shape, or processing history of the sample. The ASTM D-2240 specification, which describes a standard method for measuring Shore hardness, explicitly states that "No simple relationship exists between indentation hardness determined by this test method and any fundamental property of the material tested." (ASTM D-2240 section 4.1 (2002).) In other words, the hardness of a polymer depends on more than just its chemical composition – it also depends on the size of the sample, its shape, and the way in which the sample has been processed.

63. There is no accurate way to predict the effect of a sample's shape and thickness, or its inclusion as part of a larger construction, on its measured hardness. Even if two samples have the same chemical makeup, the hardness measured for one sample cannot be used to calculate the hardness of the other if the samples have different sizes or shapes or have been processed in different ways. Golf ball designers realize this dependency; which is one reason why they routinely measure the hardness of intermediate golf ball layers and finished golf balls rather than relying on published "plaque" hardness values.

64. The table included in the Molitor '751 patent, columns 7-8, provides an example of how difficult it is to make accurate predictions of hardness. This table reports hardnesses for two-piece sample golf balls 1, 2, and 3. These samples had the same core composition, but different cover compositions. Ball 1's cover was made of Texin 480 AR, which, measured on a standard plaque has a Shore A hardness of 86; Ball 2's cover was made of Elastollan 90, which has a plaque Shore A hardness of 90; and Ball 3's cover was made of Goodrich X-4128, which has a plaque Shore A hardness of 93. ('751 patent cols. 7-8.) If estimating the hardness of these materials on a golf ball were predictable, or followed any sort of correlation or formula, one would expect that the Texin cover would be the softest, the X-4128 cover the hardest, and the Elastollan cover somewhere in between. In fact, on the finished balls, the Texin ball was the softest (Shore C of 69), but the Elastollan ball was the hardest (Shore C of 80) and the X-4128 ball fell in between (Shore C of 74).

7 4,674,751 8

Cover	Sample No.											
	1	2	3	4	5	6	7	8	9	10	11	12
Texin 480 AR (86 ± 3) ¹	100	—	—	90	80	70	80	80	—	—	—	—
Surlyn 1702 (62) ²	—	—	—	10	20	30	—	—	10	10	20	20
Surlyn 1706 (64) ²	—	—	—	—	—	—	20	—	—	—	—	—
Surlyn 1605 (65) ²	—	—	—	—	—	—	—	20	—	—	—	—
Elastolite 90 (90) ³	—	100	—	—	—	—	—	—	90	—	80	—
Goodrich X-4128 (93) ³	—	—	100	—	—	—	—	—	—	90	—	80
Titanium dioxide	5	5	5	5	5	5	5	5	5	5	5	5
Fluorescent brightener	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Antioxidant	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
Pigment	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Release agent	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
<u>Finished Ball Data</u>												
Weight	45.2	45.3	44.9	45.1	44.7	44.5	45.0	44.8	45.1	44.8	44.4	44.5
Compression	74	70	72	72	70	73	73	70	69	71	72	74
Coefficient	.791	.788	.793	.791	.794	.787	.793	.795	.789	.790	.785	.789
Shore C Hardness	69	80	74	71	73	76	73	73	82	76	84	78

'Share A Journey'

²Shore D hardness: Elastollan 90A is a thermoplastic polyester-type urethane available commercially from BASF; Goodrich X-4128 is a thermoplastic polyester-type urethane available commercially from B. F. Goodrich.

65. Moreover, as Dr. Statz notes, the Shore D hardness of thin golf ball covers is affected by the hardness of whatever layer lies underneath the layer being measured. (Statz ¶ 63.) Thus, to calculate or predict the hardness of a thin outer cover layer (assuming such a calculation or prediction were even possible, which it is not), a person of ordinary skill in the art would have to know the hardness of the inner cover layer, and to calculate the hardness of a thin inner cover layer, one would in turn have to know the hardness of the core.

66. Because of these complications, even if a person of ordinary skill in the art knew the Shore D hardness of a standard plaque of the cover material in question (from a datasheet, for example), such a person could only guess what the hardness of that material would be if it were molded into the outer or inner cover of a golf ball.

67. Because inherency cannot be shown by "probabilities or possibilities," a disclosure of Shore D hardness for a sample having a particular size, shape, and processing history does not

inherently disclose the hardness of a sample having a different size, shape, or processing history, even if the two samples have the same chemical composition.

C. NONE OF THE ASSERTED PATENT CLAIMS IS ANTICIPATED BY NESBITT '193

68. Dr. Statz has opined that several claims of the patents-in-suit are anticipated by the Nesbitt '193 patent. I disagree.

1. No Disclosure of Polyurethane Outer Cover

69. Nesbitt does not disclose an outer cover layer comprising polyurethane, and therefore cannot anticipate any claim that recites that limitation.

2. No Disclosure of Blended-Ionomer Mantle

70. Also, Nesbitt does not disclose an inner cover layer comprising a blend of two or more ionomer resins, or a blend of two or more low-acid ionomer resins, and therefore cannot anticipate any claim that recites either of those limitations.

3. No Disclosure of Outer Cover Layer Having a Shore D Hardness of 64 or Less

71. Nesbitt '193 does not expressly or inherently disclose an outer cover layer having a Shore D hardness of 64 or less.

(a) Plaque Hardness is Not Representative of or Predictive of Outer Cover Layer Hardness

72. Dr. Statz notes that Nesbitt discloses an outer cover made of Surlyn 1855, which, he says, has an "off the ball" (plaque) Shore D hardness of 55. (Statz ¶ 67.) Similarly, Dr. Statz states that Molitor '637 discloses a cover made from Estane 58133, which, he says, has a plaque Shore D hardness of 55. (Statz p. 21, chart.) Because Shore D hardness is not an inherent property of a polymer composition (see paras. 62-63 above), the plaque Shore D hardness of Surlyn 1855 or of Estane 58133 is not representative of or predictive of the Shore D hardness of a golf ball outer cover made from either of those compositions.

(b) Nesbitt Does Not Refer to Molitor '637 for Molitor's Disclosure of Polyurethane

73. Dr. Statz takes the position that the Molitor '637 patent is "incorporated by reference" into the Nesbitt patent, and that the two references should therefore be treated as a single reference for the purpose of determining anticipation under 35 U.S.C. section 102. (Statz ¶¶ 74, 76, 77.) According to Dr. Statz, this incorporation by reference would mean that Nesbitt discloses a polyurethane outer cover as well as an inner cover comprising a blend of low-acid ionomers. (Statz p. 20, chart.)

74. Nesbitt does not explicitly state that the Molitor '637 patent is "incorporated by reference." Rather, Nesbitt's only reference to the '637 patent says:

The inner, intermediate or first layer or ply 14 and the outer cover, second layer or ply 16 of either of the layers may be cellular when formed of a foamed natural or synthetic polymeric material. Polymeric resins are preferably such as ionomer resins which are foamable. Reference is made to the application Ser. No. 155,658, of Robert P. Molitor issued into U.S. Pat. No. 4,274,637 which describes a number of foamable compositions which may be employed for one or both layers 14 and 16 for the golf ball of this invention.

(Nesbitt col. 3:51-61.)

75. Nesbitt's mention of the Molitor '637 patent occurs within Nesbitt's discussion of the possibility of using "cellular" cover layers composed of "foamable" material. Nesbitt does not identify polyurethane, or any of the many other polymers listed in the Molitor patent, as relevant to Nesbitt's invention for any reason other than those materials can be foamed. Consequently, I believe, and I think any other person of ordinary skill in the art would believe, that Nesbitt's reference to the "foamable compositions" of Molitor is intended to suggest only that the outer cover layer of Nesbitt's ball may be "foamed" or "cellular."

76. The focus of the '637 patent is not polyurethane, or "foamable compositions" generally, but foamable ionomers specifically.

77. When asked in deposition how he would characterize the Molitor '637 patent, Michael Sullivan's response was "foam covered golf balls." (Sullivan 86:15-17.)

78. At his deposition, Dennis Nesbitt testified that he did not consider his patent's mention of the Molitor '637 patent to be a reference to anything other than Molitor's use of foamable ionomers. (Nesbitt Depo. 199:7-15.) Nesbitt stated there was "no way" his reference to Molitor's patent suggested polyurethane as a potential outer cover material. (Nesbitt Depo. 235:13-21.)

4. Acushnet's Statement to the Patent Office Regarding the Materiality of Nesbitt '193

79. Finally, I note that Acushnet, when prosecuting its '172 patent, which claims the same urethane-over-ionomer construction as the patents-in-suit, told the Patent Office that Nesbitt '193 was not "material" to patentability. (See para. 206 below.) If the '193 patent was not "material" to the patentability of the '172 claims, then it cannot be "material" to any of the urethane-over-ionomer claims asserted in this lawsuit – that is, it cannot show, either by itself or in combination with other references, that these claims are anticipated or obvious.

D. CLAIMS 1-2 OF THE '130 PATENT ARE NOT ANTICIPATED BY PROUDFIT '187

80. Dr. Statz has stated that claims 1-2 of Sullivan's '130 patent are anticipated by the Proudfit '187 patent. (Statz ¶¶ 179-86.) I disagree.

1. No Disclosure of Outer Cover Layer Having a Shore D Hardness of 64 or Less

81. Proudfit '187 does not expressly disclose an outer cover layer having a Shore D hardness of less than 64. Proudfit, in fact, does not mention Shore D hardnesses at all.

82. Proudfit discloses "an outer layer of soft material such as balata or a blend of balata and other elastomers." (Statz p. 52, chart.) Proudfit does not disclose, however, that the balata or the blend of balata and other elastomers used for the outer cover layer has or should have a Shore D of less than 64. Accordingly, Dr. Statz's opinion that Proudfit anticipates claims 1-2 of the '130 patent relies on an inherency argument – that, and because "[i]t was well known to people of ordinary skill in the art in 1995 that balata had a Shore D of less than 64." (Statz p. 52, chart.) I disagree.

83. As discussed above (paras. 62-63), Shore D hardness is not an inherent or fundamental property of a polymer composition; it depends not only on the chemical makeup of the material but also on the size and shape (including the thickness) of the sample and how it has been processed. Until the hardness of a sample is measured, one can only guess what that hardness might be.

84. This uncertainty is compounded when the sample being measured is, like Proudfit's balata outer cover, a thin and relatively soft layer applied over a harder material. In this case, the durometer "feels" the hardness of the inner cover layer, raising the hardness measured on the outer cover. (See Statz ¶ 63.)

85. Because inherency cannot be proven by "possibilities or probabilities," even if persons of skill in the art would have thought it "possible" or "probable" that Proudfit's balata or balata-blend cover would have a Shore D hardness of less than 64 – and Dr. Statz cites no evidence that they would have – that evidence would be insufficient to prove inherency.

2. Mr. Hebert's Declaration is Not Proof of Inherency

86. As further evidence of inherency, Dr. Statz relies on a declaration in which Edmund Hebert claimed that the outer cover of the Wilson Ultra Tour Balata had a Shore D hardness of about 52 Shore D. (Statz p.52, chart, citing Hebert PTO Decl. ¶7.)

87. Although Mr. Hebert claims that, in the Wilson Ultra Tour Balata, "the outer cover layer was the cover claimed in United States Patent 5,314,187 to Proudfit" (Hebert PTO Decl. ¶ 5), neither Mr. Hebert nor Dr. Statz cites any evidence that would confirm this statement, and I do not believe a person of skill in the art would necessarily have recognized such a connection.

88. As I understand it, to the extent the Wilson Ultra Tour Balata ball itself is prior art, for purposes of analyzing validity it is a separate piece of prior art from Proudfit '187. Dr. Statz does not claim that the Wilson ball anticipates any claims by itself and, as I have explained,

Proudfit '187 alone also does not anticipate any claims. Therefore, claiming as Dr. Statz does that the Wilson ball has a single relevant characteristic does not assist his analysis of the separate Proudfit reference.

89. Thus, I believe Acushnet has not shown, and cannot show, clear and convincing evidence that the limitation of "an outer cover having a Shore D hardness of 64 or less" is inherently present in the Proudfit '187 reference. Proudfit therefore does not anticipate claims 1 and 2 of the '130 patent.

3. Acushnet's Statement to the Patent Office Regarding the Materiality of Proudfit '187

90. Finally, I note that Acushnet, when prosecuting its '172 patent, which claims the same urethane-over-ionomer construction as the patents-in-suit, told the Patent Office that Proudfit '187 was not "material" to patentability. (See para. 206 below.) If the '187 patent was not "material" to the patentability of the '172 claims, then it cannot be "material" to any of the urethane-over-ionomer claims asserted in this lawsuit – that is, it cannot show, either by itself or in combination with other references, that these claims are anticipated or obvious.

E. NONE OF THE ASSERTED PATENT CLAIMS IS OBVIOUS UNDER ANY OF THE PRIOR ART COMBINATIONS ACUSHNET HAS ASSERTED

1. Nesbitt '193 + Molitor '637

91. I believe that combining the Nesbitt '193 and Molitor '637 patents to achieve the claimed invention would not have been obvious to one of ordinary skill in the art. I also believe that the inventions described in the asserted claims of the patents-in-suit would not have been recognized as the predictable result of such a combination. Therefore, I believe this combination does not render any of the asserted claims obvious.

(a) No Express or Inherent Disclosure of Outer Cover Shore D Hardness of 64 or Less

92. Neither Nesbitt '193 nor Molitor '637 expressly discloses a Shore D hardness for any composition.

93. I disagree with Dr. Statz's assertion that the limitation of an "outer cover layer having a Shore D hardness of 64 or less" is met through inherency.

(i) Plaque Hardness is Not Representative of or Predictive of Outer Cover Layer Hardness

94. Dr. Statz notes that Nesbitt discloses an outer cover made of Surlyn 1855, which, he says, has an "off the ball" (plaque) Shore D hardness of 55. (Statz ¶ 67.) Similarly, Dr. Statz states that Molitor '637 discloses a cover made from Estane 58133, which, he says, has a plaque Shore D hardness of 55. (Statz p. 21, chart.) Because Shore D hardness is not an inherent property of a

polymer composition (see paras. 62-63 above), the plaque Shore D hardness of Surlyn 1855 or of Estane 58133 is not representative of or predictive of the Shore D hardness of a golf ball outer cover made from either of those compositions.

(ii) Dr. MacKnight's Golf Balls are Not Proof of Inherency

95. Dr. Statz relies on, as alleged proof of inherency, outer-cover Shore D measurements of golf balls Dr. MacKnight created for this litigation. (Statz ¶ 78.) Supposedly, these balls comprise:

- a core made from a composition described in the Nesbitt patent (MacKnight ¶ 8);
- an inner cover layer made from either a single-ionomer composition described in the Nesbitt patent (MacKnight ¶ 10), or a blended-ionomer composition described in the Molitor '637 patent (MacKnight ¶ 11); and
- an outer cover made from an Estane 58133 composition described in the Molitor '637 patent (MacKnight ¶ 13).

At this time, I have no way of knowing whether these balls are or are not what Dr. MacKnight has represented them to be, but, for the purpose of this report, I will assume that they are.

96. The materials and cover thicknesses used in these two types of balls represent only two possible combinations of the materials and thicknesses collectively disclosed by Nesbitt '193 and Molitor '637. Therefore, the hardness properties these balls exhibit are not the inevitable result of combining these two references.

97. Thus, I do not believe that a ball made from the combination of Nesbitt '193 and Molitor '637 would inevitably and necessarily have an outer cover having a Shore D hardness of 64 or less.

98. Even if this hardness were inherent to the outer cover of such a ball, I do not believe that, at the time of Sullivan's invention, a person of ordinary skill in the art would have known of that inherency. At best, such a person could only recognize a possibility or probability that a golf ball made from this combination of references might have a Shore D hardness of 64 or less.

99. I therefore believe that, in Acushnet's obviousness arguments regarding the combination of these references, the limitation of "an outer cover having a Shore D hardness of 64 or less" cannot be met through inherency.

(b) This is Not a Case Where a Combination "Obvious to Try" Establishes Obviousness under Section 103

100. I am advised that the fact that a combination was "obvious to try" might show that a patent claim was obvious, but only if the problem to be solved is one for which: (1) there exists a finite number of identified, predictable solutions, (2) a person of ordinary skill has good reason to pursue the known options within his or her technical grasp, and (3) pursuing these known options leads to an anticipated success that is likely the product not of innovation but of ordinary skill and common sense.

101. In my opinion, Nesbitt '193 and Molitor '637, if read together, would suggest at most that it might be obvious to try using a wide variety of foamed compositions as a cover material. I do

not believe this is a circumstance in which the obviousness of a combination can be shown merely by showing that the combination was "obvious to try."

102. The '637 patent discloses many possible choices of foamable cover materials in addition to polyurethane. It also suggests foamed:

- vinyl resins (5:34);
- "polyolefins such as polyethylene, polypropylene, polybutylene, transpolyisoprene, and the like, including copolymers of polyolefins" (5:37-39)
- polyamides (5:41);
- polystyrene, including ABS copolymer (5:42-44);
- acrylic resins (5:44-46);
- polyphenylene oxide resins (5:49-51);
- Surlyn (3:30-35, 5:21-23); and
- balata (5:24).

103. Only one of these materials is identified as "preferred," and that is Surlyn foam. (See para. 111 below.) Molitor gives no indication that any of the other possible cover materials might be in any way better than any other, and he certainly never suggests selecting, or even starting experimentation with, polyurethane foam as a cover material in preference to any other material.

104. The examples and claims in the '637 patent also suggest that foamed polyurethane is simply one possible choice among many. The '637 describes 21 examples of golf ball constructions, but only four (Examples 16-19) include polyurethane foam covers. (18:33-19:10.) The patent recites 24 claims, but only four (claims 10-13) mention polyurethane foam, and even then only as one choice from the group of foams of "polyurethane resins, polyolefin resins and [ionomers]."

105. Thus, if a person of skill in the art thought to use one of the foamed cover materials discussed in Molitor '637 as the outer cover layer in a Nesbitt-type ball, he would be faced with a staggering array of choices – dozens, if not hundreds. The '637 patent lists at least eight other categories of possible materials, and almost all of these categories comprise a broad assortment of individual compounds. I do not believe that a person of skill in the art would anticipate that any of these materials would improve Nesbitt's design more than any other, particularly since Molitor echoes Nesbitt's preference for ionomer foam covers. (See paras. 109-112 below.)

106. Also, the classes of foam cover materials discussed in Molitor '637 have vastly different properties and behaviors. Trying all of these classes and compounds as bases for forming cellular foamed outer covers for a Nesbitt-type ball would require developing manufacturing protocols specific to at least each separate category of compounds and the cellular materials that could be foamed from them. This would, in itself, be a daunting task.

107. In my opinion, a person of ordinary skill would not attempt such a massive undertaking without some assurance that one of the combinations would achieve a significant advance over the prior art. I do not believe that either the prior art itself or the general knowledge of one of skill in the art would provide any such assurance.

108. Thus, even if it were obvious to try using polyurethane foam as an outer cover material in a Nesbitt-type ball, this is not a case in which a combination that is merely "obvious to try" establishes invalidity under section 103. There are too many possibilities disclosed; there is no suggestion that any would provide any particular advantage; and it would be hugely impractical to try them all.

(c) Teaching Away

109. Nesbitt teaches away from the use of the polyurethane cover disclosed in Molitor '637. Where Nesbitt refers to the '637 patent, he states:

The inner, intermediate, or first layer or ply 14 and the outer cover, second layer or ply 16 or either of the layers may be cellular when formed of a foamed natural or synthetic polymeric material. Polymeric materials are **preferably such as ionomer resins** which are foamable. Reference is made to the application Ser. No. 155,658, of Robert P. Molitor issued into U.S. Pat. No. 4,274,637 which describes a number of foamable compositions of a character which may be employed for one or both layers 14 and 16 for the golf ball of this invention.

(Nesbitt '193 3:51-61 (emphasis added).) Although Nesbitt refers to Molitor '637 for its listing of "foamable" cover materials, the only one of these many compositions that Nesbitt singles out as preferable is "ionomer resins."

110. As discussed above (para. 78), Dennis Nesbitt himself believed that his patent's mention of Molitor '637 referred to nothing more than Molitor's disclosure of foamable ionomers.

111. Likewise, Molitor's '637 patent states a preference for ionomeric covers. In the abstract of the '637 patent, Molitor emphasizes that "[i]t is preferred that the golf ball cover be formed from ionic copolymers of polyolefins and unsaturated monocarboxylic acids wherein *said ionomers* incorporate zinc or sodium ions." (Molitor '637, abstract (emphasis added).) In the '637 specification, Molitor reiterates this preference, stating that "Preferred polymeric materials for use in accordance with this invention are ionomer resins" (Molitor '637 3:30-31.)

112. Thus, a person of skill in the art reading Nesbitt in combination with Molitor '637 would be led away from using polyurethane foam as an outer cover material, and would instead be encouraged to use a foamed ionomeric cover. Read separately and especially when read together, Nesbitt '193 and Molitor '637 focus one of skill in the art on the use of ionomer foams, not polyurethane foams, for the outer cover layer.

113. Also, even if one were to try using the foamed ionomer cover of Molitor '637 as the inner cover layer in a Nesbitt-type multi-layer ball, the Nesbitt '193 and Molitor '637 patents teach away from the claimed range of outer cover thicknesses.

114. The '193 patent states that the ionomeric outer cover layer "may be in a range of 0.020 to 0.100 inches." ('193 patent col. 3:24-25.) The '637 patent suggests that, regardless of what the cover layer is made of, it should be .090" to .125" thick. ('637 patent col. 4:61-5:12.) Reading these references together, one of skill in the art would be led away from creating an outer cover layer in the claimed range of 0.010 to 0.070 inches thick, and would instead be encouraged to make an outer cover layer with a thickness in the range where Nesbitt '193 and Molitor '673 overlap: 0.090 to 0.100 inches.

(d) Acushnet's Statement to the Patent Office Regarding the Materiality of Nesbitt '193

115. Finally, I note that Acushnet, when prosecuting its '172 patent, which claims the same urethane-over-ionomer construction as the patents-in-suit, told the Patent Office that Nesbitt '193 was not "material" to patentability. (See para. 206 below.) If the '193 patent was not "material" to the patentability of the '172 claims, then it cannot be "material" to any of the urethane-over-ionomer claims asserted in this lawsuit – that is, it cannot show, either by itself or in combination with other references, that these claims are anticipated or obvious.

2. Nesbitt '193 + Wu '673

116. I believe that combining the Nesbitt '193 and Wu '673 patents to achieve the claimed invention would not have been obvious to one of ordinary skill in the art. I also believe that the inventions described in the asserted claims of the patents-in-suit would not have been recognized as the predictable result of such a combination. Therefore, I believe this combination does not render any of the asserted claims obvious.

(a) No Express or Inherent Disclosure of Outer Cover Shore D Hardness of 64 or Less

117. Neither Nesbitt '193 nor Wu '673 expressly discloses a Shore D hardness for any composition.

118. I disagree with Dr. Statz's assertion that the limitation of an "outer cover layer having a Shore D hardness of 64 or less" is met through inherency.

(i) Plaque Hardness is Not Representative of or Predictive of Outer Cover Layer Hardness

119. As discussed above, the plaque hardness of the Surlyn 1855 disclosed in the Nesbitt patent is not representative of or predictive of the Shore D hardness that such a composition would exhibit as the outer cover layer of a three (or more)-piece golf ball. (See para. 72 above.)

(ii) Dr. MacKnight's Golf Balls are Not Proof of Inherency

120. Dr. Statz relies on, as alleged proof of inherency, outer-cover Shore D measurements of golf balls Dr. MacKnight created for this litigation. (Statz ¶ 84.) Supposedly, these balls comprise:

- a core made from a composition described in the Nesbitt patent (MacKnight ¶ 8);
- an inner cover layer made from either a single-ionomer composition described in the Nesbitt patent (MacKnight ¶ 10), or a blended-ionomer composition described in the Molitor '637 patent (MacKnight ¶ 11); and
- an outer cover made from a polyurethane composition described in the Wu '673 patent (MacKnight ¶ 14).

At this time, I have no way of knowing whether these balls are or are not what Dr. MacKnight has represented them to be, but, for the purpose of this report, I will assume that they are.

121. The materials and cover thicknesses used in these two types of balls represent only two possible combinations of the materials and thicknesses collectively disclosed by Nesbitt '193 and Wu '673. Therefore, the hardness properties these balls exhibit are not the inevitable result of combining these two references.

122. Thus, I do not believe that a ball made from the combination of Nesbitt '193 and Wu '673 would inevitably and necessarily have an outer cover having a Shore D hardness of 64 or less.

123. Even if this hardness were inherent to the outer cover of such a ball, I do not believe that, at the time of Sullivan's invention, a person of ordinary skill in the art would have known of that inherency. At best, such a person could only recognize a possibility or probability that a golf ball made from this combination of references might have a Shore D hardness of 64 or less.

124. I therefore believe that, in Acushnet's obviousness arguments regarding the combination of these references, the limitation of "an outer cover having a Shore D hardness of 64 or less" cannot be met through inherency.

(b) Effect of No Incorporation by Reference

125. Also, if Molitor '637 is not incorporated by reference into Nesbitt '193, the combination of Nesbitt and Wu does not disclose an inner cover layer comprising a blend of two or more ionomers or a blend of two or more low-acid ionomers, in which case the combination of Nesbitt and Wu cannot invalidate any claim that includes either of those limitations.

(c) Teaching Away

126. Additionally, as noted above (para. 109), Nesbitt teaches away from using a polyurethane outer cover, suggesting that ionomer covers are preferable. This teaching would discourage a person of skill in the art from using Wu's polyurethane cover in a Nesbitt-type multi-layer ball.

(d) The Claims at Issue in the *Ex Parte Sullivan* Appeal Were Much Broader Than the Claims Asserted in this Litigation

127. Dr. Statz notes that the Board of Patent Appeals and Interferences (BPAI) issued an opinion, *Ex Parte Sullivan*, that rejected some broad urethane-over-ionomer claims as obvious under the combination of Nesbitt '193 and Wu '673. (Statz ¶¶ 85-86.) Dr. Statz suggests that "the reasoning of the BPAI in *Ex Parte Sullivan* applies equally well to the patents-in-suit." (Statz ¶ 86.)

128. The claims rejected by the BPAI were considerably broader than those asserted in this case, as the following chart shows:

<p>1. A golf ball comprising: a core; an inner cover layer disposed on said core and having a Shore D hardness of 60, [sic] or greater [,] a thickness of from about 0.10 to about 0.01 inches, and comprising a low acid ionomer resin containing no more than 16% by weight of an alpha, beta unsaturated carboxylic acid; and an outer cover layer comprising a polyurethane material.</p>	<p>This claim includes no limitations regarding:</p> <ul style="list-style-type: none"> • the Shore D hardness of the outer cover layer; • a "blend of two or more ionomer resins"; • a blend of two or more low-acid ionomers; • the flex modulus for the inner cover layer; or • the thickness of the outer cover layer.
<p>7. A golf ball comprising: a core; an inner cover layer disposed about said core and having a thickness of from about 0.10 to about 0.01 inches, and comprising an ionomer resin including no more than 16 % by weight of an alpha, beta-unsaturated carboxylic acid and having a modulus of from about 15,000 to about 70,000 psi; and an outer cover layer disposed about said inner cover layer comprising a polyurethane material.</p>	<p>This claim includes no limitations regarding:</p> <ul style="list-style-type: none"> • the Shore D hardness of the inner cover layer; • the Shore D hardness of the outer cover layer; • a "blend of two or more ionomer resins"; • a blend of two or more low-acid ionomers; or • the thickness of the outer cover layer.
<p>13. A golf ball comprising: a core; an inner cover layer disposed on said core comprising an ionomer resin; and an outer cover layer disposed about said inner cover layer comprising a polyurethane material.</p>	<p>This claim includes no limitations regarding:</p> <ul style="list-style-type: none"> • the inclusion of a low-acid ionomer in the inner cover layer; • the Shore D hardness of the inner cover layer; • the Shore D hardness of the outer cover layer; • a "blend of two or more ionomer resins"; • a blend of two or more low-acid ionomers; • the flex modulus for the inner cover layer; • the thickness of the inner cover layer; or

	<ul style="list-style-type: none">• the thickness of the outer cover layer.
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129. I have been advised that, when considering the validity of a claim, the claim must be considered as a whole, that is, in view of all the claim's limitations and not just some subset of them. Thus, I do not believe that the BPAI's rejection of the broad claims at issue in the *Ex Parte Sullivan* appeal establishes that Nesbitt '193, or Wu '673, or the combination of the two, has any effect on the validity of the narrower claims at issue in this litigation.

130. Significantly, none of the claims at issue in *Ex Parte Sullivan* included limitations on outer-cover Shore D hardness. Accordingly, the BPAI made no determination as to whether Nesbitt '193 or Wu '673 expressly or inherently discloses such a limitation.

131. Likewise, none of the claims at issue in *Ex Parte Sullivan* recited a blend of ionomers or a blend of low-acid ionomers. Thus, the BPAI's decision does not suggest that either of these limitations is expressly or inherently disclosed by Nesbitt '193, Wu '673, or the combination of those references.

(e) Acushnet's Statement to the Patent Office Regarding Materiality of Nesbitt '193 and Wu '673

132. Finally, I note that Acushnet, when prosecuting its '172 patent, which claims the same urethane-over-ionomer construction as the patents-in-suit, told the Patent Office that Nesbitt '193 nor Wu '673 was "material" to patentability. (See para. 206 below.) If the '193 and '673 patents were not "material" to the patentability of the '172 claims, then they cannot be "material" to any of the urethane-over-ionomer claims asserted in this lawsuit – that is, neither can show, either by itself or in combination with other references, that these claims are anticipated or obvious.

3. Nesbitt '193 + Molitor '751

133. I believe that combining the Nesbitt '193 and Molitor '751 patents to achieve the claimed invention would not have been obvious to one of ordinary skill in the art. I also believe that the inventions described in the asserted claims of the patents-in-suit would not have been recognized as the predictable result of such a combination. Therefore, I believe this combination does not render any of the asserted claims obvious.

(a) No Express or Inherent Disclosure of Outer Cover Shore D Hardness of 64 or Less

134. Neither Nesbitt '193 nor Molitor '751 expressly discloses a Shore D hardness for any composition.

135. I disagree with Dr. Statz's assertion that the limitation of an "outer cover layer having a Shore D hardness of 64 or less" is met through inherency.

(i) Plaque Hardness is Not Representative of or Predictive of Outer Cover Layer Hardness

136. As discussed above, the plaque hardness of the Surlyn 1855 disclosed in the Nesbitt patent is not representative of or predictive of the Shore D hardness that such a composition would exhibit as the outer cover layer of a three (or more)-piece golf ball. (See para. 72 above.)

(ii) The Disclosure of a Shore C Hardness Does Not Inherently Disclose a Shore D Hardness

137. Dr. Statz argues that Molitor '751 does disclose an outer cover layer comprising polyurethane and having a Shore D hardness of 64 or less. (Statz ¶ 92.) Although Molitor lacks any express disclosure of Shore D hardness, Dr. Statz argues that the patent discloses a preferred cover hardness of 72 to 76 on the Shore C scale," and that a cover with this Shore C hardness "will certainly have a Shore D hardness of well below 64." (Statz ¶ 92.)

138. In other words, Dr. Statz is arguing that a cover with a Shore C hardness of 72 inherently has a Shore D hardness of 64 or less. I disagree – I do not believe that, given the certainty required under the legal principle of inherency, that a disclosing a Shore C hardness inherently discloses a Shore D hardness.

139. As mentioned above (para. 62), the ASTM D-2240 specification expressly warns against trying to convert between Shore C and Shore D, or between any other hardness scales:

This test method is based on the penetration of a specific type of indentor when forced into the material under specified conditions. The indentation hardness is inversely related to the penetration and is dependent on the viscoelastic behavior of the material. The shape of the indentor and the applied force influence the results obtained so there may be no simple relationship between the results obtained with one type of durometer and those obtained with another type of durometer or other instruments used for measuring hardness. This test method is an empirical test intended primarily for control purposes. No simple relationship is known to exist between indentation hardness determined by this test method and any fundamental property of the material tested.

(ASTM D-2240 (1995) section 4.1 (emphasis added).)

140. The 1995 edition of ASTM D-2240 included a "durometer scale comparison chart," but cautioned that "This is not and cannot be used as a conversion reference":

NOTE 2—Durometer scale comparison chart only. This is not and cannot be used as a conversion reference.

Type A	10	20	30	40	50	60	70	80	90	100	
Type B	10	20	30	40	50	60	70	80	90	100	
Type C	10	20	30	40	50	60	70	80	90	100	
Type D	10	20	30	40	50	60	60	70	80	90	100
Type DO	10	20	30	40	50	60	70	80	90	100	
Type O	10	20	30	40	50	60	70	80	90	100	
Type OO	10	20	30	40	50	60	70	80	90	100	

(ASTM D-2240 (1995) section 4.1.)

141. A person of ordinary skill in the art would thus understand D-2240 to prohibit converting a hardness from one Shore scale to another, and certainly would not purport to do so with the level of certainty required to opine that a Shore C hardness measured on the cover of a golf ball "necessarily" equates to a particular Shore D hardness.

142. As further support for his argument, Dr. Statz refers to a so-called "comparison chart" from the Rex Gauge company that was cited in the prosecution of the '873 patent. (Statz ¶ 92(c).) The Rex Gauge chart, however, contains the same warning as the D-2240 standard – that "This is not and cannot be used as a conversion chart."

Appendix B

Comparison Chart

This chart is for comparison purposes only.
This is not and cannot be used as a conversion chart.

A	10	20	30	40	50	60	70	80	90	100
B	10	20	30	40	50	60	70	80	90	100
C	10	20	30	40	50	60	70	80	90	100
D	10	20	30	40	50	60	70	80	90	100
DO	10	20	30	40	50	60	70	80	90	100
O	10	20	30	40	50	60	70	80	90	100
OO	10	20	30	40	50	60	70	80	90	100
M	30	40	50	60	70	80	90			

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143. Given that both the 1995 ASTM D-2240 specification and the 2001 Rex Gauge chart expressly disapprove of attempts to correlate Shore C and Shore D hardness, and that no general formula is known for such a conversion, I do not believe that a golf ball measured as having an outer-cover Shore C hardness of 72 would inevitably and necessarily exhibit an outer-cover Shore D hardness of 64 or less. Even if this property were inherent, I do not believe a person of ordinary skill in the art would have known of that inherency.

144. Other evidence cited by Dr. Statz does not dissuade me from this conclusion.

145. Dr. Statz claims that Table 19 of Callaway Golf's U.S. Patent No. 6,905,648 "shows that a Shore C hardness of 73 correlates to a Shore D hardness of 47." (Statz ¶ 92(b).) I disagree. This data does not imply that Shore C values can be accurately translated into Shore D values, or that a sample with a Shore C hardness of 73 inevitably and necessarily has a Shore D hardness of 47.

The only conclusion that can reasonably be drawn from these two measurements is that a certain sample of Hytrel G-4074 exhibited a Shore C hardness of 73 and a Shore D hardness of 47. I also note that this pair of measurements illustrates the unreliability of the Rex Gauge and D-2240 "comparison charts," which, if used to predict Shore D from Shore C, would correlate a Shore C hardness of 70 or more to a Shore D hardness of 50 or more. (See paras. 140, 142 above.)

146. Dr. Statz also writes that the patents-in-suit give a "translation" between Shore C and Shore D by stating that the outer cover layer preferably "has a Shore D hardness of about 45 (i.e. Shore C hardness of about 65)." (Statz ¶ 92(a), citing '293 patent col. 3:49-54.) The text cited from the '293 patent is not an example of a "translation" between Shore C and Shore D. At most, it suggests that an outer cover with a Shore D hardness of "about" 45 might possibly exhibit a Shore C hardness of "about" 65. This text does not indicate that a cover such as that discussed in Molitor '751 with a Shore C hardness of 72 will inevitably and necessarily have a Shore D hardness of 64 or less.

147. Dr. Statz relies on a declaration submitted by Mark Binette in support of a Callaway Golf patent application in which Mr. Binette refers to Shore C and Shore D measurements of certain ionomer-over-ionomer golf balls. (Statz ¶ 92(e), citing 7/22/97 Binette Decl. from prosecution history of U.S. Patent No. 5,803,831.) These values, says Dr. Statz, indicate "a correlation between Shore C of 75 and Shore D of 49, and between Shore C of 72 and Shore D of 48." (Statz ¶ 92(e).) These measurements, however, do not establish a general or universal "correlation" between Shore C and Shore D measurements. All they show is that certain ionomer-over-ionomer golf balls exhibited certain Shore C hardnesses and certain Shore D hardnesses. Mr. Binette's data does not show that a polyurethane cover such as that discussed in Molitor '751 with a Shore C hardness of 72 will inevitably and necessarily have a Shore D hardness of 64 or less. And again, as in the "Table 19" discussion above, I note that this pair of measurements shows the unreliability of the Rex Gauge and D-2240 "comparison charts" – if either chart were used to predict Shore D from Shore C, it would correlate a Shore C hardness of 70 or more to a Shore D hardness of 50 or more. (See paras. 140, 142 above.)

148. Dr. Statz additionally relies on a chart he says Du Pont provides "for the purpose of translating Shore hardness measurements," which, he claims, "shows that Shore C measurements of 77 or less translate to a Shore D of 58 or less." (Statz ¶ 92(d), citing Ex. O to Acushnet's Comments to Callaway Golf's Response to Office Action in the reexamination proceedings.) I note, however, that this chart expressly states that "CONVERSIONS ARE APPROXIMATE" and "VALUES DEPENDENT ON GRADES AND CONDITIONS OF MATERIALS INVOLVED." I further note that the chart does not specify what materials its "durometer conversion" table supposedly applies to. Therefore, I believe this chart shows, at most, that a material that exhibits a Shore C measurement of 77 or less might possibly exhibit a Shore D hardness of 58 or less. It does not show that a polyurethane cover such as that discussed in Molitor '751 with a Shore C hardness of 72 will inevitably and necessarily have a Shore D hardness of 64 or less.

(iii) Dr. MacKnight's Golf Balls are Not Proof of Inherency

149. Dr. Statz cites, as further support for his theory of inherency, outer-cover Shore D measurements of golf balls Dr. MacKnight created for this litigation. (Statz ¶ 93.) Supposedly, these balls comprise:

- a core made from a composition described in the Nesbitt patent (MacKnight ¶ 8);
- an inner cover layer made from either a single-ionomer composition described in the Nesbitt patent (MacKnight ¶ 10), or a blended-ionomer composition described in the Molitor '637 patent (MacKnight ¶ 11); and
- an outer cover made from a polyurethane-ionomer composition described in the Molitor '751 patent, except that Surlyn 1605 (8940) was substituted for Surlyn 1702 (9970) (MacKnight ¶ 15).

At this time, I have no way of knowing whether these balls are or are not what Dr. MacKnight has represented them to be, but, for the purpose of this report, I will assume that they are.

150. The materials and cover thicknesses used in these two types of balls represent only two possible combinations of the materials and thicknesses collectively disclosed by Nesbitt '193 and Molitor '751. Therefore, the hardness properties these balls exhibit are not the inevitable result of combining these two references.

151. Thus, I do not believe that a ball made from the combination of Nesbitt '193 and Molitor '751 would inevitably and necessarily have an outer cover having a Shore D hardness of 64 or less.

152. Even if this hardness were inherent to the outer cover of such a ball, I do not believe that, at the time of Sullivan's invention, a person of ordinary skill in the art would have known of that inherency. At best, such a person could only recognize a possibility or probability that a golf ball made from this combination of references might have a Shore D hardness of 64 or less.

153. I therefore believe that, in Acushnet's obviousness arguments regarding the combination of these references, the limitation of "an outer cover having a Shore D hardness of 64 or less" cannot be met through inherency.

154. Also, if Molitor '637 is not incorporated by reference into Nesbitt '193, the combination of Nesbitt and Molitor '751 does not disclose an inner cover layer comprising a blend of two or more ionomers or a blend of two or more low-acid ionomers, in which case the combination of Nesbitt and Molitor '751 cannot invalidate any claim that includes either of those limitations.

155. Additionally, as noted above (para. 109), Nesbitt teaches away from using a polyurethane outer cover, suggesting that ionomer covers are preferable. This teaching would discourage a person of skill in the art from using the polyurethane-ionomer cover of Molitor '751 in a Nesbitt-type multi-layer ball.

(b) Acushnet's Statement to the Patent Office Regarding the Materiality of Nesbitt '193

156. Finally, I note that Acushnet, when prosecuting its '172 patent, which claims the same urethane-over-ionomer construction as the patents-in-suit, told the Patent Office that Nesbitt '193

was not "material" to patentability. (See para. 206 below.) If the '193 patent was not "material" to the patentability of the '172 claims, then it cannot be "material" to any of the urethane-over-ionomer claims asserted in this lawsuit – that is, it cannot show, either by itself or in combination with other references, that these claims are anticipated or obvious.

4. Proudfit '187 + Molitor '637

157. I believe that combining the Proudfit '187 and Molitor '637 patents to achieve the claimed invention would not have been obvious to one of ordinary skill in the art. I also believe that the inventions described in the asserted claims of the patents-in-suit would not have been recognized as the predictable result of such a combination. Therefore, I believe this combination does not render any of the asserted claims obvious.

(a) No Express or Inherent Disclosure of Outer Cover Shore D Hardness of 64 or Less

158. Neither Proudfit '187 nor Molitor '637 expressly discloses a Shore D hardness for any composition.

159. I disagree with Dr. Statz's assertion that the limitation of an "outer cover layer having a Shore D hardness of 64 or less" is met through inherency.

(i) Proudfit's Disclosure of a Balata Outer Cover Does Not Inherently Disclose an Outer-Cover Shore D Hardness

160. As discussed above (para. 85), I disagree that a person of skill in the art would have regarded Proudfit's disclosure of "an outer layer of soft material such as balata or a blend of balata and other elastomers" as an inherent disclosure of an outer cover layer with a Shore D hardness of 64 or less.

(ii) Dr. MacKnight's Golf Balls are Not Proof of Inherency

161. Dr. Statz relies on, as alleged proof of inherency, outer-cover Shore D measurements of golf balls Dr. MacKnight created for this litigation. (Statz ¶ 102.) Supposedly, these balls comprise:

- a core made from a composition described in the Proudfit '187 patent (MacKnight ¶ 9);
- an inner cover layer made from either a blended-ionomer composition described in the Proudfit '187 patent (MacKnight ¶ 12), or a blended-ionomer composition described in the Molitor '637 patent (MacKnight ¶ 11); and
- an outer cover made from an Estane 58133 composition described in the Molitor '637 patent (MacKnight ¶ 13).

At this time, I have no way of knowing whether these balls are or are not what Dr. MacKnight has represented them to be, but, for the purpose of this report, I will assume that they are.

162. The materials and cover thicknesses used in these two types of balls represent only two possible combinations of the materials and thicknesses collectively disclosed by Proudfit '187

and Molitor '637. Therefore, the hardness properties these balls exhibit are not the inevitable result of combining these two references.

163. Thus, I do not believe that a ball made from the combination of Proudfit '187 and Molitor '637 would inevitably and necessarily have an outer cover having a Shore D hardness of 64 or less.

164. Even if this hardness were inherent to the outer cover of such a ball, I do not believe that, at the time of Sullivan's invention, a person of ordinary skill in the art would have known of that inherency. At best, such a person could only recognize a possibility or probability that a golf ball made from this combination of references might have a Shore D hardness of 64 or less.

165. I therefore believe that, in Acushnet's obviousness arguments regarding the combination of these references, the limitation of "an outer cover having a Shore D hardness of 64 or less" cannot be met through inherency.

(b) This is Not a Case Where a Combination "Obvious to Try" Establishes Obviousness under Section 103

166. Additionally, I believe that Molitor '637 establishes, at most, that using polyurethane foam as a cover material is, at most, one of many options that would be obvious to try, and that this case is not one in which the obviousness of a combination can be shown merely by showing that the combination was "obvious to try." (See paras. 100-108 above.)

(c) Teaching Away

167. Also, as discussed above (para. 111), the only cover composition the '637 patent identifies as any better than any other is one formed from foamed ionomers, which are "preferred." Thus, a person of skill in the art reading Proudfit '187 in combination with Molitor '637 would be led away from using polyurethane foam as an outer cover material, and would instead be encouraged to use a foamed ionomeric cover.

(d) Acushnet's Statement to the Patent Office Regarding the Materiality of Proudfit '187

168. Finally, I note that Acushnet, when prosecuting its '172 patent, which claims the same urethane-over-ionomer construction as the patents-in-suit, told the Patent Office that Proudfit '187 was not "material" to patentability. (See para. 206 below.) If the '187 patent was not "material" to the patentability of the '172 claims, then it cannot be "material" to any of the urethane-over-ionomer claims asserted in this lawsuit – that is, it cannot show, either by itself or in combination with other references, that these claims are anticipated or obvious.

5. Proudfit + Wu '673

169. I believe that combining the Proudfit '187 and Wu '673 patents to achieve the claimed invention would not have been obvious to one of ordinary skill in the art. I also believe that the inventions described in the asserted claims of the patents-in-suit would not have been recognized

as the predictable result of such a combination. Therefore, I believe this combination does not render any of the asserted claims obvious.

(a) No Express or Inherent Disclosure of Outer Cover Shore D Hardness of 64 or Less

170. Neither Proudfit '187 nor Wu '673 expressly discloses a Shore D hardness for any composition.

171. I disagree with Dr. Statz's assertion that the limitation of an "outer cover layer having a Shore D hardness of 64 or less" is met through inherency.

(i) Proudfit's Disclosure of a Balata Outer Cover Does Not Inherently Disclose an Outer-Cover Shore D Hardness

172. As discussed above (para. 85), I disagree that a person of skill in the art would have regarded Proudfit's disclosure of "an outer layer of soft material such as balata or a blend of balata and other elastomers" as an inherent disclosure of an outer cover layer with a Shore D hardness of 64 or less.

(ii) Dr. MacKnight's Golf Balls are Not Proof of Inherency

173. Dr. Statz relies on, as alleged proof of inherency, outer-cover Shore D measurements of a golf ball Dr. MacKnight created for this litigation. (Statz ¶ 105.) Supposedly, this ball comprises:

- a core made from a composition described in the Proudfit '187 patent (MacKnight ¶ 9);
- an inner cover layer made from a blended-ionomer composition described in the Proudfit '187 patent (MacKnight ¶ 12); and
- an outer cover made from a polyurethane composition described in the Wu '673 patent (MacKnight ¶ 14).

At this time, I have no way of knowing whether this ball is or is not what Dr. MacKnight has represented it to be, but, for the purpose of this report, I will assume that it is.

174. The materials and cover thicknesses used in this ball represent only one possible combination of the materials and thicknesses collectively disclosed by Proudfit '187 and Wu '673. Therefore, the hardness properties these balls exhibit are not the inevitable result of combining these two references.

175. Thus, I do not believe that a ball made from the combination of Proudfit '187 and Wu '673 would inevitably and necessarily have an outer cover having a Shore D hardness of 64 or less.

176. Even if this hardness were inherent to the outer cover of such a ball, I do not believe that, at the time of Sullivan's invention, a person of ordinary skill in the art would have known of that inherency. At best, such a person could only recognize a possibility or probability that a golf ball made from this combination of references might have a Shore D hardness of 64 or less.

177. I therefore believe that, in Acushnet's obviousness arguments regarding the combination of these references, the limitation of "an outer cover having a Shore D hardness of 64 or less" cannot be met through inherency.

(b) Acushnet's Statement to the Patent Office Regarding the Materiality of Proudfit '187 and Wu '673

178. Finally, I note that Acushnet, when prosecuting its '172 patent, which claims the same urethane-over-ionomer construction as the patents-in-suit, told the Patent Office that Proudfit '187 and Wu '673 were not "material" to patentability. (See para. 206 below.) If the '187 and '673 patents were not "material" to the patentability of the '172 claims, then neither can be "material" to any of the urethane-over-ionomer claims asserted in this lawsuit – that is, neither of these references can show, either by itself or in combination with other references, that these claims are anticipated or obvious.

6. Proudfit +Molitor '751

179. I believe that combining the Proudfit '187 and Molitor '751 patents to achieve the claimed invention would not have been obvious to one of ordinary skill in the art. I also believe that the inventions described in the asserted claims of the patents-in-suit would not have been recognized as the predictable result of such a combination. Therefore, I believe this combination does not render any of the asserted claims obvious.

(a) No Express or Inherent Disclosure of Outer Cover Shore D Hardness of 64 or Less

180. Neither Proudfit '187 nor Wu '673 expressly discloses a Shore D hardness for any composition.

181. I disagree with Dr. Statz's assertion that the limitation of an "outer cover layer having a Shore D hardness of 64 or less" is met through inherency.

(i) Proudfit's Disclosure of a Balata Outer Cover Does Not Inherently Disclose an Outer-Cover Shore D Hardness

182. As discussed above (para. 85), I disagree that a person of skill in the art would have regarded Proudfit's disclosure of "an outer layer of soft material such as balata or a blend of balata and other elastomers" as an inherent disclosure of an outer cover layer with a Shore D hardness of 64 or less.

(ii) The Disclosure of a Shore C Hardness Does Not Inherently Disclose a Shore D Hardness

183. As discussed in paragraphs 137-148 above, regarding the combination of Nesbitt '193 and Molitor '751, I do not believe that a golf ball measured as having an outer-cover Shore C hardness of 72 would inevitably and necessarily exhibit an outer-cover Shore D hardness of 64

or less. Even if this property were inherent, I do not believe a person of ordinary skill in the art would have known of that inherency.

(iii) Dr. MacKnight's Golf Balls are Not Proof of Inherency

184. Dr. Statz relies on, as alleged proof of inherency, outer-cover Shore D measurements of a golf ball Dr. MacKnight created for this litigation. (Statz ¶ 113.) Supposedly, this ball comprises:

- a core made from a composition described in the Proudfit '187 patent (MacKnight ¶ 9);
- an inner cover layer made from a blended-ionomer composition described in the Proudfit '187 patent (MacKnight ¶ 12); and
- an outer cover made from a polyurethane-ionomer composition described in the Molitor '751 patent, except that Surlyn 1605 (8940) was substituted for Surlyn 1702 (9970) (MacKnight ¶ 15).

At this time, I have no way of knowing whether this ball is or is not what Dr. MacKnight has represented it to be, but, for the purpose of this report, I will assume that it is.

185. The materials and cover thicknesses used in this ball represent only one possible combination of the materials and thicknesses collectively disclosed by Proudfit '187 and Molitor '751. Therefore, the hardness properties this ball exhibits are not the inevitable result of combining these two references.

186. Thus, I do not believe that a ball made from the combination of Proudfit '187 and Molitor '751 would inevitably and necessarily have an outer cover having a Shore D hardness of 64 or less.

187. Even if this hardness were inherent to the outer cover of such a ball, I do not believe that, at the time of Sullivan's invention, a person of ordinary skill in the art would have known of that inherency. At best, such a person could only recognize a possibility or probability that a golf ball made from this combination of references might have a Shore D hardness of 64 or less.

188. I therefore believe that, in Acushnet's obviousness arguments regarding the combination of these references, the limitation of "an outer cover having a Shore D hardness of 64 or less" cannot be met through inherency.

(b) Acushnet's Statement to the Patent Office Regarding the Materiality of Proudfit '187

189. Finally, I note that Acushnet, when prosecuting its '172 patent, which claims the same urethane-over-ionomer construction as the patents-in-suit, told the Patent Office that Proudfit '187 was not "material" to patentability. (See para. 206 below.) If the '187 patent was not "material" to the patentability of the '172 claims, then it cannot be "material" to any of the urethane-over-ionomer claims asserted in this lawsuit – that is, it cannot show, either by itself or in combination with other references, that these claims are anticipated or obvious.

7. Wilson Ultra Tour Balata + Titleist Professional or Titleist Professional 2P

190. Dr. Statz describes the Titleist Professional and Titleist Professional 2P golf balls as wound-core and solid-core balls, respectively, in which the cover comprised "a polyurethane very similar, if not identical, to the polyurethane described in the Wu patent." (Statz ¶ 208.) Dr. Statz argues that "it would have been obvious to a person of ordinary skill in the art to modify the Wilson Ultra Tour Balata golf ball by using the polyurethane of the Titleist Professional or the Titleist Professional 2P as the material for the outer cover layer of the ball." (Statz ¶¶ 209-10.)

191. I believe that combining the Wilson Ultra Tour Balata with either the Titleist Professional or Titleist Professional 2P would not have been obvious to one of ordinary skill in the art. I also believe that the inventions described in the asserted claims of the patents-in-suit would not have been recognized as the predictable result of such a combination. Therefore, I believe this combination does not render any of the asserted claims obvious.

(a) No Express or Inherent Disclosure of a Low-Acid Ionomer

192. Even if the mantle layer of the Wilson Ultra Tour Balata ball comprises a low-acid ionomer, or a blend of low-acid ionomers, I do not believe a person of ordinary skill in the art would have known that any ionomer or ionomers in the mantle were low-acid.

193. I also believe that a person of ordinary skill in the art would not have had any way of experimentally determining the acid content of any ionomer or ionomers in the mantle of the Ultra Tour Balata ball. I expect it would be extremely difficult to reverse-engineer an ionomic mantle layer, particularly one comprising a blend of ionomers, to determine the acid content of each ionomer component. At the time of Sullivan's invention, I was not aware of any method for conducting such an analysis.

194. Also, I do not believe that, at the time of Sullivan's invention, one of skill in the art would have known that the mantle composition of the Wilson Ultra Tour Balata ball was any composition specifically described in the Proudfit '187 patent. The '187 patent draws no connection between itself and any commercially available golf ball.

195. Even if the Wilson Ultra Tour Balata golf ball were marked, at the time of Sullivan's invention, with the '187 patent number, that would only suggest that the ball, as a whole, is within one or more claims of that patent. Since the broadest claim of Proudfit '187 (claim 1) requires only that the inner layer comprise an "ionomer resin," one could not infer from the patent marking what kinds of ionomers the mantle of the Ultra Tour Balata might include.

(b) No Express or Inherent Disclosure of Inner-Cover Flex Modulus

196. Similarly, I do not see how a person of ordinary skill in the art would recognize the inner cover layer of the Ultra Tour Balata as having a flex modulus between 15,000 and 70,000 psi. Without knowing the specific ionomers used in the mantle, one of skill in the art would not know what datasheets to consult for that information. Also, I do not expect that a person of ordinary skill in the art would have known any way to determine that flex modulus experimentally, since the flex modulus of the inner cover layer cannot be measured from the ball itself.

(c) Not Obvious That Merely Substituting One Cover For the Other Would Achieve an Outer-Cover Shore D Hardness of 64 or Less

197. Even if one thought to substitute the polyurethane cover of the Titleist Professional or Titleist Professional 2P for the outer cover of a Wilson Ultra Tour Balata, and making such a substitution did, in fact, produce a golf ball with an outer cover layer having a Shore D hardness of 64 or less, I do not think that a person of ordinary skill in the art would have known or thought that this outer-cover hardness would be the necessary and inevitable result of that substitution.

F. ACUSHNET FILED AND PROSECUTED ITS OWN PATENT ON A MULTI-LAYER URETHANE-OVER-IONOMER GOLF BALL, AND CANNOT IN GOOD FAITH ASSERT THAT SUCH A CONSTRUCTION WAS NOT PATENTABLE WHEN SULLIVAN INVENTED IT

198. In 1997, three of Acushnet's golf ball designers, Edmund Hebert, William Morgan, and Dean Snell, filed a patent application on a urethane-over-ionomer multi-layer golf ball. This application was based on work that apparently began in 1996. (CW320909.)

199. In filing and prosecuting this application, Mr. Hebert, Mr. Morgan, and Mr. Snell, all persons of ordinary skill in the art, must have believed their purported invention was novel and non-obvious. The Patent Office granted a number of patents based on this application, so it appears that the Patent Office also considered this technology patentable over the known prior art at the time.

200. Importantly, the work by Acushnet's designers came after (and, I am informed, without knowledge of) the invention of the patents at issue in this case by Michael Sullivan. Mr. Sullivan's patents all have an earlier priority date than the applications that Hebert, Morgan and Snell filed for Acushnet.

201. One of the patents that issued to Acushnet's designers is U.S. Patent No. 5,885,172, which was filed in 1997 and issued in 1999. This patent names Edmund Hebert, William Morgan, and Dean Snell as inventors and claims:

(1) A golf ball comprising a cover and a core, wherein said cover is disposed about the core and said cover comprises (a) an inner cover layer of a flexural modulus of at least about 65,000 psi; and (b) an outer cover layer having a Shore D hardness of greater than 30 to 60, having a thickness of less than 0.050 inches and comprising a thermoset material that includes at least one of a castable reactive liquid material and reaction products thereof.

202. The '172 specification states that "ionomer resins and blends thereof" are "preferred" as cover materials. ('172 patent col. 5:42-45.)

203. Claims 1 and 7 therefore claim a urethane-over-ionomer construction for a three (or more)-piece ball. The ball described by these claims is not significantly different from the ball claimed in the patents-in-suit. In fact, if Acushnet's invalidity arguments against the patents-in-suit are accepted at face value, those same arguments would prove the invalidity of claims 1 and 7 of the '172 patent. (See para. 210 below.)

204. Acushnet cannot claim that the recitation of a "thermoset" or "castable" material in the outer cover layer distinguishes its '172 patent either from the prior art or from Sullivan's patents.

- (i) Claims 1-4 of Wu's '673 patent specifically recite a cover made from a "thermosetting polyurethane composition." Moreover, the '172 patent admits that Wu teaches a process for applying a cover made of "a castable reactive liquid." ('172 patent, col. 8:16-19, 8:47-50.)
- (ii) Molitor '637 discusses a cover stock "formed by casting a liquid thermoset polyurethane foam." ('637 patent, col. 18:64-45.)
- (ii) Example 4 in Sullivan's patent specification describes "Castable Polyurethane Covered Multi-Layer Balls." ('293 patent, cols. 22-23.) Sample balls 23-25 are specifically described as having "thermoset urethane covers." ('293 patent, col. 23:28-29.)

205. Also, I note that the '172 patent does not require that the cover be formed by "casting"; it requires only that the cover be made from a "castable" material. The '172 patent says as much: "The castable, reactive liquid employed to form the thermoset material can be applied over the inner core using a variety of application techniques such as spraying, dipping, spin coating, or flow coating methods which are well known in the art." ('172 patent col. 8:7-11.)

206. During the prosecution of the '172 patent, Acushnet submitted an information disclosure statement (IDS) to the Patent Office listing the Nesbitt '193, Proudfit '187, and Wu '673 patents as prior art. Dr. Statz relies on all of these to invalidate the asserted Sullivan claims. Yet, in its cover letter to the Patent Office when seeking its own patent on the same technology, Acushnet told the Patent Office that, of these references, "[n]one are deemed to be material to the patentability of the present invention." (IDS dated 9/10/98, included in '172 file history, CW300639.) In other words, when prosecuting its own application on urethane-over-ionomer multi-layer golf balls, Acushnet told the Patent Office that the Nesbitt, Wu, and Proudfit references – at least one of which appears in every obviousness combination Acushnet relies on in this litigation – do not render such an invention unpatentable.

207. I interpret Acushnet's conflicting positions as follows. I believe that Hebert, Morgan, and Snell, the inventors of Acushnet's '172 patent, reasonably believed that a urethane-over-ionomer construction in a three (or more)-piece ball was novel and non-obvious, and thus patentable – even in 1997, when they first sought patent protection for such a construction – since they had no way of knowing of Sullivan's prior invention of this technology, or of his pending patent applications.

208. The filing and prosecution of Acushnet's patents on urethane-over-ionomer multi-layer golf balls is further evidence that Hebert, Morgan, and Snell, all persons of at least ordinary skill in the art, would not have, and in fact, did not, consider this technology obvious when they thought of it in 1996, and therefore could not have considered it obvious at the time Sullivan invented it years before.

209. Because Acushnet applied for and obtained patents on urethane-over-ionomer multi-layer golf balls, I do not see how Acushnet can, in good faith, take the position in this case that Sullivan's earlier-filed patents on the same technology are invalid. I consider it exceptional that, after telling the Patent Office that the Nesbitt, Proudfit, and Wu references were not material to the patentability of a urethane-over-ionomer multi-layer ball, and after the Patent Office had a full opportunity to analyze and apply those references to the claims Acushnet was seeking and made no rejections based on those references, Acushnet has claimed in this litigation that these same references invalidate Sullivan's urethane-over-ionomer claims.

G. UNDER ACUSHNET'S INVALIDITY ARGUMENTS, THE CLAIMS OF ACUSHNET'S '172 PATENT ARE ALSO INVALID

210. Appendix C to this report includes claim charts that show that if Acushnet's characterizations and arguments regarding Proudfit '187, Wu '673, and Molitor '637 are accepted as correct, then claims 1, 7, and 11 of the '172 patent are obvious under (1) the combination of Proudfit '187 and Wu '673; and (2) the combination of Proudfit '187 and Molitor '637.

H. SECONDARY FACTORS OF NON-OBVIOUSNESS

1. Commercial Success

211. I understand that showing the "commercial success" of a product embodying the claimed invention establishes one of the "Graham factors," or "secondary considerations," that supports a finding that the claimed invention was not obvious.

212. I understand that, for commercial success to bear on the non-obviousness of an invention, there must be a "nexus" between the patented technology and the commercial success; that is, there is no "nexus" if the use of the patented technology is merely incidental to the success of a product that incorporates it.

213. As a preliminary matter, I am advised that Dr. Garth Wilkes has submitted an expert report in which he concludes that the Pro V1, Pro V1x, and Pro V1 Star infringe the asserted claims. I will assume for purposes of my analysis that Dr. Wilkes is correct, and that the accused balls are embodiments of the claimed technology.

(a) The Pro V1 has Enjoyed Extraordinary Commercial Success

214. It is my understanding that the Titleist Pro V1 and Pro V1x are "the most successful balls in the history of golf," and that they "far outsell all competitors." (Bellis ¶ 40.) Mr. Bellis describes the success of the Pro V1 as "phenomenal." (Bellis ¶ 69.)

215. I interpret Dr. Statz's report to concede that the Titleist Pro V1 and Pro V1x have, in fact, achieved extraordinary commercial success. (Statz ¶¶ 214-17.)

216. I therefore have no doubt that the Titleist Pro V1 and V1x have, in fact, been huge commercial successes.

(b) The Primary Reason for the Pro V1's Commercial Success is the Incorporation of Sullivan's Patented Technology

217. I believe that the tremendous success of the Pro V1 family of golf balls is directly attributable to the balls' superior performance. This performance is primarily the result of the use of the technology claimed in the patents-in-suit.

218. In a sworn affidavit submitted in the Bridgestone-Acushnet golf ball litigation, William Morgan, Acushnet's Senior VP of Research & Development for Golf Balls, stated the connection between the performance of the Pro V1 and its success:

The reason for the success of the Titleist Pro V1 beginning in 2000 is that like no other ball before it, Pro V1 delivered the combined attributes of long distance off the tee with soft feel and control into the green. (Morgan ¶ 73.)

219. Mr. Morgan also suggests that the success of the Pro V1 indicates that the ball represented a new idea – "The market's response to the Pro V1 clearly indicates that something new had been created." (Morgan ¶ 73.)

220. Mr. Bellis's declaration also states that the "superior technology that delivers superior performance" in the Pro V1 is the primary reason for the Pro V1's success. (Bellis ¶ 72.)

221. Mr. Love's declaration relies on a Golf Magazine article, "Great Leaps Forward," that cites the Pro V1 as the most recent of only fourteen "groundbreaking" golf inventions since 1890. (Love ¶¶ 17-18 and attached article.) Mr. Love quotes this article for its statement that "the Titleist Pro V1 'became the industry leader almost the minute it entered the market in the fall of 2000' due to its 'superior mix of distance and control around the greens.'" (Love ¶ 18.)

222. Attempting to deny the link between the Pro V1's performance and its commercial success, Dr. Statz downplays the Pro V1 as "a good performing golf ball" that achieves "good distance off the tee" in combination with "good spin and control." (Statz ¶ 218.) It is my understanding and belief that the performance of the Pro V1 is substantially better than "good," and that it is, in fact, exceptional. For example, sworn affidavits that Acushnet has submitted in its golf-ball litigation with Bridgestone characterize the Pro V1's performance with superlatives:

- "exceptional distance off the tee" (Love ¶ 12)
- "optimum spin profile" (Love ¶ 12)
- "the Titleist Pro V1 family of golf balls has performed better than any other solid golf ball I have tested" (Love ¶ 30)

- "long-flying, easy-to-control" (Bellis ¶ 68)
- "superior technology that delivers superior performance" (Bellis ¶ 72)
- "outstanding distance" (Bellis ¶ 74)

223. Nevertheless, Dr. Statz disputes that the commercial success of the Pro V1 and V1x is due to their use of the technology claimed in the patents-in-suit. (Statz ¶ 216.) He cites, among other factors responsible for the balls' success, Titleist's marketing and the influence of pro players on the buying public. (Statz ¶¶ 249-50.)

224. I do not dispute that Acushnet has a reputation for savvy marketing. However, I doubt that any product could be a commercial success without some degree of marketing, so I expect that a showing of a nexus between the patented technology and "commercial success" cannot be precluded by the fact that a product benefitted to some extent from marketing.

225. Moreover, Acushnet has aggressively marketed all of its premium golf ball products, including the Titleist Professional, which it sold prior to the introduction of the Pro V1. But by Acushnet's own statements and admissions, the Pro V1 was a great leap in performance and commercial success over the Acushnet balls it replaced. (See Bellis ¶ 40.) In particular, Mr. Bellis stated that "[w]hile solid construction balls existed on the market for a long time, none has had anything remotely approaching the success we have had with the Pro V1 family." (Bellis ¶ 71.) Clearly, marketing is not the primary reason for the success of the Pro V1.

226. I also note that Acushnet's marketing of the Pro V1 has emphasized its "resilient ionomer casing layer" and "high performance urethane elastomer cover." (E.g. CW280214, CW329360.) Thus, to the extent Acushnet claims the balls' success has been due to marketing, it is important to consider that part of what is being marketed is the ball's superior construction and performance. If Acushnet's marketing of the Pro V1 has been successful, one of the factors contributing to that success is that the ball's design enables Acushnet to advertise the urethane outer cover and ionomer mantle and their effects on performance.

227. Other varieties of Titleist and Pinnacle golf balls, including previous generations of such balls, have also been the subject of Acushnet's marketing, and that none of those balls has sold as well as the Pro V1 and V1x. (See Bellis ¶ 40.) In particular, Mr. Bellis stated that "While solid construction balls existed on the market for a long time, none has had anything remotely approaching the success we have had with the Pro V1 family." (Bellis ¶ 71.)

228. Dr. Statz states, "If the technology of the patents-in-suit were such a breakthrough over the prior art, I would have expected Spalding to have taken advantage of this technology well before it did." (Statz ¶ 251.) This is speculation. Neither Dr. Statz nor I knows the reason Spalding did not commercialize Sullivan's urethane-over-ionomer invention sooner, but it could have been due more to business and manufacturing considerations than any lack of faith in the performance of the urethane-over-ionomer construction.

229. For example, Top-Flite's production facilities in the mid-90's were optimized for ionomer covers, not for urethane covers. Also, urethane is comparatively more expensive than Surlyn,

and Top-Flite was concerned that, because of the positioning of its brand, it could not successfully market a ball at the price it would have to charge for a urethane-covered product.

230. Dr. Statz argues that, if the success of the patented technology were responsible for the success of the Pro V1 and V1x, then the Callaway Golf Rule 35 ball, which also embodies some of Sullivan's claims, would have taken a large share of the golf ball market. (Statz ¶ 249.) This again is speculation. There are many reasons which could explain why Acushnet succeeded in selling the Pro V1 while Callaway Golf struggled with the Rule 35.

231. Moreover, there is evidence showing the relative success of an Acushnet golf ball that uses the patented technology (the Pro V1) versus one that did not (the Titleist Professional). In the case of Callaway Golf, the Rule 35 was its first golf ball product, so there is no other Callaway Golf ball against which to compare the Rule 35.

232. Before the introduction of the Pro V1, most Titleist-sponsored players had been playing the Titleist Professional. (Statz ¶ 246.) Thus, assuming the "pyramid of influence" marketing strategy worked equally well for the Professional as it has for the Pro V1, the fact that Acushnet subsequently sold far more Pro V1's than Professionals to amateurs suggests that the "pyramid of influence" alone cannot explain the increased sales of the Pro V1.

233. The difference, I believe, is related to the difference in performance. As Mr. Bellis notes in his declaration, the Professional was not as good a ball for amateur players as the Pro V1 because the Professional "was less durable, had too much sidespin and [was] not as long" as other balls. (Bellis ¶ 74.) In contrast, Mr. Bellis notes that the Pro V1 "provides outstanding distance, durability, not-too-much sidespin [and] 'drop and stop; control' better than any other ball for average golfers, just like it does for the Tour Pros." (Bellis ¶ 74.)

234. Tour pros have confirmed that the factors Mr. Bellis cites here are what makes the Pro V1 perform well. For example:

- Ernie Els: "The Pro V1 is great. The ball goes farther and I spin the ball better." (CW366591.)
- Vijay Singh: "It flies higher. It flies farther. It stops on the green. It does everything you want a golf ball to do." (CW366591.) "The ball goes forever. And you can stop the ball, you can spin the ball. it's pretty much what everyone is looking for." (CW366588.)
- Lee Westwood: "With the Pro V1, I'm definitely longer off the tee, but I'm not giving up anything in terms of control. It feels soft, and there's plenty of spin around the green." (CW280216.)
- Steve Stricker: "It's made a big difference in my game. Around the greens, it's phenomenal. I'm able to spin the ball a lot more than I've ever been able to before." (CW366591.)
- Mike Weir: "You can see the difference in the distance, the trajectory, and the feel around the greens. It's really a big move forwards." (CW366591.)
- Steve Elkington: "The Pro V1 has the combination of going far off the tee, getting more control with the short shots, and having a soft feel around the green." (CW366591.)

- Davis Love III: "The Titleist Pro V1x gives me more control and feel around the greens. Ball flight, extra distance, and more control is a pretty good package." (CW366588.)

235. The enhanced durability, low sidespin, superior distance, and better controllability of the Pro V1 vis-a-vis the prior art are all attributable to Sullivan's technology.

(i) "Enhanced durability" comes from the use of a polyurethane outer cover thick enough to resist cuts and scuffs but thin enough to have a negligible effect on longer shots.

Previously, "durability" was associated with hard ionomer covers, which were notorious for having poor feel and spin. Balata and soft ionomer covers had better feel and spin, but were not durable. Urethane covers on prior art balls lacking the other patented features were more durable than balata or soft ionomer covers, but tended to diminish distance and add unwanted spin.

(ii) "Low sidespin" and "superior distance" both result from the relative thinness of the outer cover and the presence of the hard ionomer inner cover. When hit by a driver or a longer iron, the ionomer character of the ball dominates, producing low spin and good distance.

(iii) Better controllability results from the urethane outer cover. When hit with a short iron, the urethane character of the ball prevails over the ionomer character. The oblique contact between the clubface and the urethane cover imparts spin to the ball, which allows skilled players to manipulate shots around the green.

236. Dr. Statz suggests that the aerodynamics and core composition of the ball, as well as quality control and manufacturing methods, are also responsible for the Pro V1's success. (Statz ¶ 220-26.) I am aware of no evidence that suggests that any of these factors is nearly as important to the Pro V1's performance, and success, as the incorporation of Sullivan's cover technology, and Dr. Statz cites none.

237. I note that for the 2005 versions of the Pro V1 and V1x, Acushnet reformulated the core compositions. (E.g. CW329359-62, CW334982.)

238. I also note that Acushnet redesigned the 2007 version of the Pro V1 and V1x to have "enhanced aerodynamics." (Bellis ¶ 77.) Presumably, there was some room for improvement in the previous aerodynamic design that warranted this change. Again, Dr. Statz does not cite any figures showing that this change improved the commercial success of the Pro V1 or V1x.

239. By contrast, I observe that Acushnet has never made any change to the fundamental design of the Pro V1 cover layers – since the Pro V1's introduction in 2000, every version of the Pro V1, V1x, and V1 Star has had a polyurethane outer cover over an ionomer inner cover. I observe that Dr. Wilkes has concluded that all of these versions infringe the asserted claims.

240. It appears, therefore, that the aspects of the Pro V1 covered by the Sullivan patents have performed well enough that they have not required any redesign, whereas the same cannot be said for the ball's aerodynamics or core.

241. Furthermore, although I do not doubt that Acushnet holds patents on multiple aspects of the Pro V1, I have observed that many of the patents listed on the Pro V1 packaging were filed after 2000, when the original Pro V1 was introduced and became an immediate success.

242. Therefore, I believe that the technology most proximately responsible for the Pro V1's superior performance and immediate success was the urethane-over-ionomer multi-layer construction described in the Sullivan patents, and incorporated into the original Pro V1 ball. By the time any incremental changes were made to later versions of the Pro V1, the ball was already an overwhelming success, and I am not aware of any evidence that any of these later changes caused any increase in sales of Pro V1 balls.

243. Because marketing cannot explain the success of the Pro V1 over its predecessors, and because the factors most often associated with the Pro V1's superior performance are all attributable to the incorporation of Sullivan's technology, I believe that the primary reason for the commercial success of the Pro V1 is the increased performance obtained by using the patented invention.

(c) The Pro V1 is "Commensurate in Scope" With the Asserted Claims

244. I disagree with Dr. Statz's conclusion that the Pro V1 is not "commensurate in scope" with the asserted patent claims.

245. Dr. Statz argues that none of the asserted claims is narrow enough to describe the exact construction of the Pro V1. (Statz ¶¶ 242-43.) Of course, that is not the case; the claim limitations are appropriate. He further argues that even if the Pro V1 embodies those claims, it is not "commensurate in scope" with any claim that could read on any other configurations. (Statz ¶¶ 243.)

246. Dr. Statz's argument focuses mainly on the claims that recite a range of thicknesses for the inner and outer cover layers. (Statz ¶¶ 234-37.) I note, first of all, that not all of the asserted claims include limitations on the thickness of the cover layers. (See, for example, '293 claim 4.)

247. For the claims that do recite ranges of thicknesses for cover layers, I observe that these ranges are limited to a reasonable, narrow range that works. The largest range claimed for a cover thickness is 0.010" to 0.100". The difference between a cover layer .010" thick and one .100" thick is only .090", which represents only 11% of the radius of a 1.68" diameter golf ball. (See, for example, '873 claim 1, inner cover.) Some claims recite a range of 0.020" to 0.070", a span of 0.050", which is 6% of the radius of a standard-size golf ball. (See, e.g., '873 claim 1, outer cover.) Some dependent claims (e.g. '156 claims 3, 11) are more narrow still, reciting ranges of 0.030" to 0.060", a difference of only 0.030", or 3.6% of the ball's radius.

248. I am not aware of any rule under which an infringing product is not "commensurate in scope" with the infringed claim simply because the claim does not recite every specific detail of the product's construction, or when the infringer has availed himself of a claimed range by selecting a property within, but not fully coextensive with, that range.

249. Therefore, I consider it immaterial to the analysis of commercial success that the asserted claims are not so narrowly written as to cover the accused products and nothing else.

2. Unexpected Results

250. I am aware that an additional secondary factor of non-obviousness can be established with evidence that the claimed invention achieved "unexpected results" relative to the closest prior art. To analyze this factor, I must consider what properties those of skill in the art would have expected the claimed construction to exhibit, had they considered such a construction.

251. In this case, one can be fairly certain of what persons of skill in the art would have expected from combinations of the prior art, since the allegedly invalidating prior art was well-known among golf ball designers.

252. Dr. Statz emphasizes that multi-layer construction, ionomer inner covers, and polyurethane covers had been in existence for a long time before Sullivan developed his invention. (Statz ¶¶ 199, 200, 209.) This is certainly true, but I think Dr. Statz is incorrect when he concludes that, because the prior art was old and well known, and because certain elements of the patented combinations were known, combining the prior art references to produce Sullivan's invention must have been obvious. (Statz ¶ 209.) I draw the opposite conclusion – that because the prior art had existed for so long and become so well known among those skilled in the art, there had to be a reason why those persons did not implement the prior-art combinations that Dr. Statz claims would have been so obvious.

253. Dr. Statz states that the benefits of Sullivan's invention would have been well known to persons of skill in the art and that any benefit of using Sullivan's design was "to be expected." (Statz ¶ 258.) Here, Dr. Statz and I disagree.

254. I concur that "through the years, golf ball designers routinely examine and experiment with available cover materials." (Statz ¶ 36.) Given this tendency, the fact that no one succeeded in making a urethane-over-ionomer three-piece ball before Sullivan did strongly suggests that persons of skill in the art either did not think to do so, or did not think such an effort would be worth pursuing because it was too difficult or because it would not result in any significant improvements.

255. The persons of greatest skill in the art were certainly familiar with the prior art (having, in many instances, created that prior art themselves) and, by virtue of their employment at golf ball companies, were motivated to design the best golf balls possible. Therefore, if those persons, as Acushnet now argues, would have "expected" that combining the various prior art references as Dr. Statz says would result in improved performance, these designers had every opportunity and motivation to create such combinations.

256. In fact, Acushnet cannot point to a single instance of anyone, even those of extraordinary skill in the art, adding a polyurethane outer cover to an ionomer inner cover to create a usable multi-layer golf ball before Michael Sullivan did so.

257. The only person known to have even attempted such a construction is Dennis Nesbitt, who, despite his experience with multi-layer designs and ionomeric inner covers, was unable to create a usable prototype with a polyurethane outer cover. (Nesbitt Depo. 79:18-20, 93:13-19 (re "Concept B" ball); 94:15-18 (same).) Nesbitt ended up abandoning the idea. (Nesbitt Depo. 94:22-95:2, 95:13-17, 100:1-4, 103:9-17.)

258. The only conclusion that can be drawn from the widespread knowledge of the prior art and the fact that no one, before Sullivan, successfully implemented a urethane-over-ionomer golf ball, is that even the most skilled golf ball designers either did not expect any benefit from such a design, did not think the construction was possible, or did not consider the combination at all.

259. Thus, I believe the "unexpected result" of Sullivan's invention is twofold: (1) that a urethane-over-ionomer ball is technologically feasible, and (2) that it demonstrates significant performance advantages over the prior art.

(a) One "Unexpected Result" Was That Making a Urethane-Over-Ionomer Ball Was Possible At All

260. One of the references Acushnet relies on as prior art, the '751 patent, was developed by my colleagues, Robert Molitor and Terry Melvin, at Spalding. I was a consultant for Spalding in the early 1990s. Mr. Molitor, who in the late 60's was the first to develop a polyurethane golf ball cover, was also the sole inventor of the '637 patent, which Acushnet also relies on as prior art in this case.

261. As reflected in the '751 patent, Mr. Molitor and Mr. Melvin were trying to improve the feel and controllability of ionomer covers by making covers from a polyurethane-ionomer blend. This composition formed the cover of the Top-Flite Tour Edition 90 and 100 golf balls circa 1991.

262. Even after the release of the blended-cover Tour Edition, polyurethane proved to be so troublesome to work with that, by 1993, Spalding had eliminated the urethane-ionomer blend from the Tour Edition and replaced it with an ionomeric composition. Thus, when Sullivan developed his urethane-over-ionomer ball, he did so in spite of a trend among his Spalding colleagues away from polyurethane cover materials.

263. Also, at the time of Sullivan's invention, Dennis Nesbitt was also well aware of the problems of making a multi-layer ball with a polyurethane outer cover and ionomer inner cover. Mr. Nesbitt had, some years earlier, tried to make such a ball, but gave up after observing serious problems with the prototypes. Mr. Nesbitt's failed experiments with the urethane-over-ionomer design are discussed in more detail below in connection with the "failure of others" factor. (See paras. 292-299 below.)

(b) Another "Unexpected Result" Was that Sullivan's Design Achieved Substantial Improvements in Performance

264. The use of a thin polyurethane outer cover over a hard ionomer inner cover achieves performance benefits over the prior art that those of skill in the art evidently did not appreciate or expect.

Improvements Over Proudfit '187 and the Wilson Ultra Tour Balata

265. Among the prior art Acushnet cites is the work James Proudfit undertook at the Wilson Sporting Goods Co., a major golf ball manufacturer. The invention described in Proudfit's '187 patent, which Acushnet alleges is embodied in the Wilson Ultra Tour Balata golf ball, was a multi-layer ball with a blended low-acid ionomer inner cover. The outer cover comprised a mixture of balata and polybutadiene. (Proudfit '187, abstract.)

266. Given that, by the time Proudfit's patent application was filed in 1991, polyurethane golf ball covers had been known for more than 20 years, I can only conclude that Proudfit either did not perceive any advantage in using a polyurethane outer cover on his ball, or did not think it possible to do so.

267. A later Wilson golf ball patent noted that the durability and distance of the '187 ball left room for improvement. (See U.S. Patent No. 6,152,836, col. 2:27-30.) Had Proudfit known that applying a polyurethane outer cover was possible, and expected that the resulting ball would exhibit excellent durability and distance, he presumably would have made such a ball, or at least discussed it in his patent.

Improvements Over Wu '673 and the Titleist Professional and Titleist Professional 2P

268. Acushnet relies on a patent filed in 1990 by its former employee, Shenshen Wu, and the Titleist Professional and Professional 2P balls that supposedly embody that patent. Wu's '673 patent describes a golf ball with a polyurethane cover. Even though Nesbitt's patent on a three-layer golf ball with an ionomer inner cover had issued in 1984 – six years before Wu filed her application – Wu makes no suggestion in her patent that her polyurethane cover might be usable over an ionomer inner cover. In fact, Wu's patent mentions "three-piece" balls but defines such balls as having a wound core, not a solid inner layer like Nesbitt's invention. ('673 patent col. 1:22-23.) Thus, I can only infer that Wu either did not perceive any advantage in using a polyurethane outer cover on her ball, or did not think it possible to do so.

269. Acushnet also cites, as prior art, the Titleist Professional and Professional 2P, golf balls that Acushnet claims embody the polyurethane outer cover described in Wu's '673 patent. The Professional had a wound core; the Professional 2P had a solid core. (Statz ¶ 208) Again, given that both Nesbitt's three-piece, ionomer-mantle construction and polyurethane covers were well known by the time the Professional was introduced in 1993, I must infer that Acushnet's golf ball designers either did not perceive any benefit to using an ionomer inner cover layer, or did not think such a construction was compatible with a polyurethane outer cover.

270. In 2000, many tour pros switched from the Titleist Professional (supposedly an embodiment of the Wu '673 patent) to the Pro V1. (Statz ¶ 246.) Their comments regarding the performance of the Pro V1, therefore reflect ways in which the Pro V1, which incorporates

Sullivan's design, represented an improvement over the Titleist Professional. (See para. 234 above.)

Improvements Over Nesbitt '193

271. Although Nesbitt's '193 golf ball offered good feel and spin, it suffered from poor durability and relatively short distance. ('293 patent col. 3:6-20.)

272. Sullivan discovered that adding a polyurethane cover over an ionomeric inner cover produced a golf ball with better distance and durability than a Nesbitt ball, but without sacrificing the desirable "feel," "click," and spin properties of Nesbitt's design. ('293 patent col. 3:21-29.)

273. This combination of desirable properties is often cited as the reason for the superior performance of the Pro V1. (See paras. 233-234 above.)

Improvements Over Molitor '637 and Molitor '751

274. Also, ionomer-covered golf balls were known for having an undesirable "hard" feel and low spin. (Molitor '637 col. 1:48-54, col. 2:29-33.) In the late 1970's, Robert Molitor attempted to solve this problem by using cellular or "foamed" preparations of elastomers and, in particular, ionomers. (Molitor '637, abstract and 2:34-46.) Molitor, however, was himself the inventor of the polyurethane golf ball cover, having developed that design in 1967. If Molitor had expected that the poor feel and spin of ionomer-covered balls could be remedied, with no sacrifice of distance or durability, by applying a polyurethane outer cover, he surely would have undertaken such a construction. He did not.

275. In the early 1990's, polyurethane covers were generally known among those of skill in the art to lack resiliency, that is, they tended to lower a ball's coefficient of restitution. Golf balls with polyurethane covers typically lacked the distance attainable with ionomeric covers.

276. Robert Molitor and Terry Melvin of Spalding attempted to enhance the performance of polyurethane covers by developing polyurethane-ionomer blends such as that described in the Molitor '751 patent. The Top-Flite Tour Edition 90 and 100 were two-piece balls that used this polyurethane-ionomer composition. Although these balls exhibited reasonably good distance, they suffered from durability problems; in play, the cover would quickly develop an undesirable fuzzy texture. By comparison, Sullivan's invention features excellent distance as well as very good durability.

277. Had Molitor or Melvin, both of whom were highly skilled in golf ball design, known or expected that Sullivan's urethane-over-ionomer construction were possible and would be so much better than the construction they described in their '751 patent, I am sure they would have tried to create such a ball.

278. Since no one, before Sullivan, developed a usable polyurethane-over-ionomer golf ball, I conclude that no one of skill in the art would have expected these advantages from this design.

At the very least, persons of skill in the art evidently did not expect this construction to improve performance as much as it does; if they had, someone certainly would have undertaken the effort to implement such a design.

(c) Hebert, Morgan, and Snell Presumably Thought Urethane-Over-Ionomer Construction Achieved Unexpected Results

279. As discussed in greater detail in above (paras. 198-209, Edmund Hebert, William Morgan, and Dean Snell, the inventors named on Acushnet's own urethane-over-ionomer multi-layer ball patents, filed a patent application in 1997 on a multi-layer golf ball with a urethane-over ionomer construction.

280. Assuming that Acushnet and its employees were not deliberately attempting to patent an invalid idea, I must assume that Messrs. Hebert, Morgan, and Snell, all of whom were persons skilled in the art, either did not believe the prior art made a urethane-over-ionomer multi-layer ball obvious, or recognized that what might otherwise be an obvious combination of the prior art led to unexpectedly good results.

(d) The Unexpected Results are Commensurate in Scope With the Asserted Claims

281. Finally, I believe that the unexpectedly good performance of the Pro V1 is largely attributable to Sullivan's invention (see paras. 233-235 above), and that the asserted claims are sufficiently narrow to be "commensurate in scope" with the Pro V1.

3. Long-Felt Need and Industry Praise

282. I understand that an additional secondary factor of non-obviousness is shown by evidence that the claimed invention fulfilled a "long-felt need" and/or earned praise from others in the industry.

283. Dr. Statz and I agree that there was a long-felt need for a golf ball that exhibited superior distance and durability while maintaining controllability and feel around the green. (See Statz ¶ 253.) William Morgan, Acushnet's VP of Golf Ball R&D, estimates that this need for a "best of both worlds" ball has been recognized for at least 25 years. (Morgan ¶ 73.)

284. I disagree, however, with Dr. Statz's argument that the Pro V1 does not fulfill this long-felt need because "there will always be a desire for a ball that has length off the tee and control around the greens." (Statz ¶ 254.) The fact that an as-yet unknown design might someday prove to be an even better solution to the "best of both worlds" problem does not negate the fact that Sullivan's patented construction, and the balls that embody it, are by far the best solution so far discovered.

285. Mr. Morgan himself, in his affidavit in the Bridgestone-Acushnet litigation, comments that the Pro V1 has fulfilled the desire for a "best of both worlds" golf ball "like no other ball before it." (Morgan ¶ 73.)

286. Tour professionals have issued similar comments. For example, I am aware that when Phil Mickelson began playing the Pro V1 in 2000, he was so impressed with the ball that he called it the "Tour Perfect." (CW280203.) For a top tour player like Mr. Mickelson to describe a ball as "perfect" is strong evidence that Mr. Mickelson considered the Pro V1 the fulfillment of a long-felt need.

287. Mr. Mickelson has also stated that the Pro V1 has had "a greater impact on golf than when steel replaced hickory in club shafts" (CW280329) and that "I honestly believe that if you are not playing this golf ball then you are at a disadvantage to the entire field" (CW366590).

288. Davis Love III, in the sworn affidavit he submitted in Acushnet's golf-ball litigation with Bridgestone, has also implied that he considers the Pro V1 the best known solution to the needs of pro golfers:

"The Pro V1 is obviously accepted by many, many professionals as the ball that best meets their needs." (Love ¶ 28.)

"[T]he Titleist Pro V1 family of golf balls has performed better than any other solid golf ball I have tested. I can say that the Pro V1 has been the ball of choice for the majority of golfers on tour, as was the Titleist Professional before it, and were the Titleist balata balls before that. This tells me that most professional golfers find that Acushnet technology best meets their needs." (Love ¶ 30.)

289. I have read the documents labeled CW320903-11, which I understand are documents Acushnet submitted to the Patent Office to establish the patentability of the Titleist Pro V1.

290. The document produced as CW320910-11 is an email from Edmund Hebert that describes his testing of some prototype three-piece balls that incorporated a soft cover over a harder ionomer mantle. In this email, Mr. Hebert mentions the "age-old" problem of creating a ball with good distance and also good feel.

291. I note that the prototype ball that Hebert considered a breakthrough had an ionomeric cover, not a urethane cover such as Acushnet eventually used on the Pro V1. (CW320910-11.) I therefore assume that Acushnet later decided that adding a urethane outer cover to the ionomer inner cover made an even better ball than the prototype that Hebert considered such a significant advance. If Hebert's prototype ball solved to the "age-old" problem he cited, then the Pro V1 represents an even better solution to the same problem.

4. Failure of Others

292. I understand that an additional secondary factor of non-obviousness is established by showing that others had tried and failed to make the claimed invention before the patentee succeeded in doing so.

293. I am aware that Dennis Nesbitt attempted to make a urethane-over-ionomer three-piece ball in the early 1980's, when he was working on the technology later described in the '193 patent.

(Nesbitt Depo. 85:1-9, 102:10-24.) I am also aware that Mr. Nesbitt considered his effort to make this ball a failure. (Nesbitt Depo. 94:22-95:2, 95:13-17, 100:1-4, 103:9-17.)

294. At his deposition, Mr. Nesbitt explained that he did not consider himself the inventor of the urethane-over-ionomer three-piece ball. (Nesbitt Depo. 249:13-15.) When asked who he thought the inventor of that technology was, Mr. Nesbitt mentioned Michael Sullivan. (Nesbitt Depo. 249: 4-12.)

295. Mr. Nesbitt testified that he could not produce a satisfactory urethane-over-ionomer golf ball, and that he dropped the project due to problems he was having getting the urethane outer cover to adhere to the ionomer inner layer. (Nesbitt Depo. pp. 94-95, 103, 208-211.)

296. Dr. Statz argues that Nesbitt did, in fact, succeed in making the invention claimed in the patents-in-suit. (Statz ¶ 260.) I note, however, that Dr. Statz presents no formal argument of anticipation or invalidity based on Nesbitt's urethane-over-ionomer prototype. I would expect Dr. Statz to present such an analysis if he could show that Nesbitt's prototype did in fact represent "the claimed invention."

297. I know of no witness who could better assess the success or failure of Nesbitt's prototype than Mr. Nesbitt himself, who unequivocally pronounced it a failure. (Nesbitt Depo. 228:3-9.)

298. Although I see no need to second-guess Mr. Nesbitt's conclusion that his prototype was a failure, I believe the problems he described having with this prototype would, in fact, have made it unsuitable for use as a golf ball. I believe the lack of adhesion between the outer and inner covers would lead to a number of problems, such as poor durability and low coefficient of restitution, that would render it unsuitable for its intended purpose. Nesbitt evidently reached the same conclusion, causing him to abandon his research into this design.

299. Mr. Nesbitt's unsuccessful attempt to create a usable urethane-over-ionomer three-piece ball therefore represents evidence that others had tried and failed to create the claimed invention, a factor that I believe weighs strongly in favor of a finding that Sullivan's invention was not obvious.

5. Inability or Failure to Design Around

300. I understand that an additional secondary factor of non-obviousness is met by showing that it is not possible or not desirable to "design around" the claimed invention, that is, redesign the infringing product in a way that avoids infringement.

301. I am informed that, since first becoming aware of the '293 patent in 2001, and the '156, '130, and '873 patents some time afterward, Acushnet has made no changes to the Pro V1 balls that would bring those products outside the scope of Sullivan's claims.

302. I note that, over the same period, Acushnet has made changes to other aspects of the Pro V1. The Pro V1 Star and V1x, for example, incorporate a dual core, rather than the single core of the Pro V1. The Pro V1x has a different dimple pattern than the Pro V1 (the V1x has 332 dimples, the V1 has 392). According to Mr. Bellis, the aerodynamics of the Pro V1 and V1x

were redesigned for the 2007 versions of those products. (Bellis ¶ 77.) Mr. Bellis also states that the 2007 Pro V1x has a softer cover than before. (Bellis ¶ 77.)

303. Thus, although Acushnet has implemented various changes to the Pro V1 balls since their introduction, Acushnet has never changed the design in a way that would avoid infringement of the patents-in-suit.

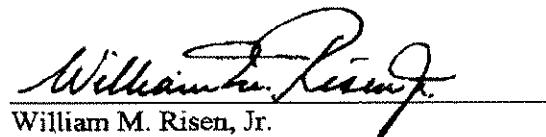
304. Dr. Statz explains that Acushnet obtained opinions of counsel stating that the patents-in-suit were invalid, and that Acushnet has consequently felt it unnecessary to design around those patents. (Statz ¶ 271.) I do not see how Acushnet could reasonably have relied on these opinions, however, since Acushnet has successfully prosecuted patent claims on a urethane-over-ionomer multi-layer construction that are very similar to the claims of the patents-in-suit. (See paras. 198-209 above.)

305. Given that Acushnet could not have reasonably believed that the patents-in-suit were invalid, that the Pro V1 balls infringe these patents, and that infringement of these patents carries the risk of sizable liability, I have to assume that Acushnet would design around the patents if it were possible to do so without losing the performance advantages the patented technology confers.

VIII. CONCLUSION

306. I reserve the right to rebut any arguments or evidence offered in response to this report, and to supplement this report based on newly presented evidence or further analysis. I also reserve the right to supplement or amend this report based on the Court's construction of the patents-in-suit. I also intend to use graphics and/or demonstrative exhibits to illustrate some of the facts and opinions I have stated here.

Dated: July 6, 2007



William M. Risen, Jr.

CERTIFICATE OF SERVICE

I hereby certify that on July 6, 2007, I served the **EXPERT REPORT OF WILLIAM M. RISEN, JR.** on opposing counsel at the following addresses in the following manner:

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APPENDIX A

CURRICULUM VITAE

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Education:

Walnut Hills High School, Cincinnati, Ohio, 1958
Sc.B. Chemistry, (Chemistry Honors), Georgetown University, 1962
Ph.D. Chemistry, Purdue University, 1967
Sigma Xi, Phi Lambda Upsilon, Monsanto Fellow

Employment:

Brown University

1975- Professor of Chemistry, Brown University
1972-1980 Chairman, Department of Chemistry, Brown University
1972-1975 Associate Professor of Chemistry
1967-1972 Assistant Professor of Chemistry
1966-1967 Research Fellow-Instructor, Brown University
F. M. C. Fellow

External Appointments

1991-1992 Visiting Professor McGill University, Montreal, Canada
1998 Visiting Scientist: Paul Scherrer Institute of ETH-Zurich and Swiss
Federal Science Foundation.
2002 - 2003 Foreign Invitational Fellowship, Japan Society for the
Promotion of Science.

Affiliations:

American Chemical Society
Materials Research Society
Sigma Xi

Institutional Service (Brown University):

Chair of the Brown University Faculty 1993 - 1994
Chairman, Department of Chemistry, 1972 - 1980
Faculty Executive Committee, 1992-1995, Vice Chair 1992 - 93; Chair 1993-1994
Associate Director, Materials Research Laboratory, 1981 - 1986

Inorganic Glasses Research Group (Materials Research Laboratory)
(Coordinator), 1973 - 1986

Advisory Committee on the Resumed Undergraduate Education
Program, 1972 - 1976

Physical Science Council, Brown University 1972 - 1977

Department Chairmen Agenda Committee, 1973 - 1980

Task Force on Non-Academic and General Affairs of the University
(Chairman), 1974 - 1975

Minority Student Advisor, 1977 - 1981

Freshman Advisor, 1981 - 1991; 1997 - 2001

Sophomore Advisor, 1992 - 1996; 1998- 2001

Task Force on Research, (Chair), 1978 - 1979

Center for Energy Studies, Executive Committee, 1978 - 1984

Chemistry-Geology Building Planning Committee, Chair, 1979 - 1980

Campus Advisory Committee on Special Studies, 1982 - 1984

University Research Council, 1981 - 1987

Project on Compensation-Coordination Committee, 1981

Dean of College Committee on Integrated Curricula, 1984

Departmental Committees; Graduate Admissions 1968 -72, 2004 - 2006 (Chair) 1999-
2001 Curriculum Committee, 1984; Undergraduate Program, 1999 (Chair),
Preliminary and Ph. D. thesis committees 1966 - 2006 Committee on Admissions
and Financial Aid (CAFA), 1985 - 1988; Chair, 1987 - 1988

Committee on South Africa, 1985 - 1986

Faculty Scholars Fund, Board 1982 - 1990

Division of Engineering Visiting Committee, 1986 - 1987, Chairman

Athletic Advisor, 1984 - 1987, 2006 -

Charles Evans Hughes Society; Executive Committee, 1986 - 1990

Dean of Admission and Financial Aid, Selection Committee, 1987 - 1988

Center for Advanced Materials Research, Executive Committee,
1988-1992

Advisory Council: Center for the Advancement of College Teaching,
1990 -96, Executive Committee, 1996- 2003

Committee to Select the Director of Campus Security, 1990 - 1991

University Task Force on Teaching Assistants, 1991

Chemistry, Geology, Environmental Science Teaching Facility
Committee, 1991- 1993, Chair

Academic Advisor: Basketball, 1992 - 1995

Athletic Advisory Council, 1990 - 1994, Chairman, 1990 - 1992

Ad Hoc Committee on Financial Aid, 1992 - 1993

Faculty Agenda Committee, 1992 - 1995
Brown University Sports Foundation, Board of Directors, 1992 -96
Campus Ad Hoc Committee on Campus Safety, Chair (1992)
Academic Council, Brown University, 1994-95
Committee on Medical Faculty Appointments 1999 – 2003
Captain, Brown University Police and Security, Selection Committee, 2007
Faculty Advisor, Varsity Baseball, 2006 -
Honorary Degree Advisory Committee,
1996-2000, Chair 1997-2000, Chair 2005-07
Sigma Xi, Scientific Honorary Society, President, Brown Univ., 2007-

External Service:

Technical Advisory Committee, Rhode Island Lung Assoc., 1969-76
Consultant, National Science Foundation (Materials Science), 1977-82;
National Science Foundation Visiting Committees:
Stanford University (Chair),
University of Chicago,
Purdue University.
Task Force on Cooperative Advances in Chemical Science and
Technology, (Co-chairman) 1979-80
NSF, DOD, DOE Program Reviews and Committees (various, 1968 -)
American Chemical Society; Presidential Conference, 1980
Board of Directors, Council for Chemical Research, 1980-82 (Founding Board)
Provost's Science Advisory Committee, Georgetown University 1981 - 83
American Chemical Society-Board/Council Committee on Chemistry
and Public Affairs (CCPA) 1982-91
Congressional Fellows Selection Committee (American Chemical Society-CCPA) Chair,
1983-85
Research and Development Funding Committee (American Chemical Society -CCPA),
Chair, 1987-88
National Research Council - Chemistry Task Force-Implementation
Group
Visiting Committee: Williams College
American Chemical Society Accreditation Committee Ad Hoc
WPI-Rutman Professor Selection Committee
International Scientific Exchange Award, NSRC - Canada,
sabbatical leave at McGill University, 1991
External examiner; Faculty of Graduate Studies, McGill University, 1994, 1995, 1998.
Visiting Scientist Fellowship, Paul Scherrer Institute, Switzerland, 1998
Gordon Conference on Ion-Containing Polymers, Co-Chair, 1999.
Judicial Performance Review for the Supreme Court of Rhode Island 1996- 2000
Consultant: Chemical and Managerial Matters; US and International Companies and Law
Firms
Content Consultant - High School Chemistry; Merrill Publishing Co.,
1988- 1992

Publications
William M. Risen, Jr.

1. Infrared Bands from Alkali Ion Motion in Solution, with W. F. Edgell, A. T. Watts, and John Lyford, IV, *J. Amer. Chem. Soc.* **88**, 1815 (1966).
2. The Mass Spectrum and Preparation of Pure Manganese Pentacarbonyl Hydride, with W. F. Edgell, *J. Amer. Chem. Soc.* **88**, 5451 (1966).
3. Rate of Air Oxidations of Vanadium(II) in Acidic Aqueous Media in the Presence of Anions, with J. E. Earley, *Chem. Anal.* **55**, 76 (1966).
4. The Infrared Spectrum and Vibrational Assignments for Pentacarbonyl-manganese Hydride, with W. F. Edgell, J. W. Fisher, and G. Asato, *Inorg. Chem.* **8**, 1103 (1969).
5. Spectroscopic Studies of Metal-Metal Bonding. I. Absorption and Laser Raman Spectra and Vibrational Analyses of $\text{Cl}_3\text{MCo}(\text{CO})_4$ (M = Sn, Ge, Si), with K. L. Watters and J. N. Brittain, *Inorg. Chem.* **8**, 1347 (1969).
6. Spectroscopic Studies of Metal-Metal Bonded Compounds, with K. L. Watters, *Inorg. Chem. Acta Rev.* **3**, 129 (1969).
7. Computer Animation: On-line Dynamic Display in Real Time, with J. S. Walton, *J. Chem. Educ.* **46**, 334 (1969).
8. Far Infrared Sealed Liquid Cell with Polyethylene Windows, with A. T. Tsatsas, *Appl. Spectry.* **24**, No. 3, 383 (1970).
9. The Photochemistry of Peroxodiphosphates. The Oxidation of Water and Two Alcohols, with R. L. Lussier and J. O. Edwards, *J. Phys. Chem.* **74**, 4039 (1970).
10. Quantized Ion Motion in Solution, with A. T. Tsatsas, *J. Amer. Chem. Soc.* **92**, 1789 (1970).
11. The Intermolecular Vibration of Ions in Solution, with W. F. Edgell, J. Lyford, IV, R. Wright, and A. Watts, *J. Amer. Chem. Soc.* **92**, 2240 (1970).
12. Cation Motion in Ionic Copolymers, with A. T. Tsatsas, *Chem. Phys. Letters* **7**, 354 (1970).

13. Vibrational Motion of Cations in Ionic Glasses, with G. J. Exarhos, *Chem. Phys. Letters* **10**, 484 (1971).
14. Cation Motion in Anionic Fields of the Polyelectrolytic Salts of Ethylenemethacrylic Copolymers, with A. T. Tsatsas and J. W. Reed, *J. Chem. Phys.* **55**, 3260 (1971).
15. Spectroscopic Studies of Metal-Metal Bonding. II. The Variation of Metal-Metal Bond Strengths and Substituents from the Vibrational Analyses of $X_3MCo(CO)_4$ (M = Sn, Ge; X = I, Br, Cl), with K. L. Watters and W. M. Butler, *Inorg. Chem.* **10**, 1970 (1971).
16. Cation Vibrations in Inorganic Oxide Glasses, with G. J. Exarhos, *Solid State Commun.* **11**, 755 (1972).
17. The Nature of Alkali Metal Ion Interactions with Cyclic Polyfunctional Molecules. I. Vibrations of Alkali Ions Encaged by Crown Ethers in Solution, with A. T. Tsatsas and R. W. Stearns, *J. Amer. Chem. Soc.* **94**, 5247 (1972).
18. Spectroscopic Studies of Metal-Metal Bonding. III. Vibrational Spectra and Analyses of $M[Co(CO)_4]_2$ (M = An, Cd, Hg), with R. J. Ziegler, J. M. Burlitch, and S. E. Hayes, *Inorg. Chem.* **11**, 702 (1972).
19. Spectroscopic Studies of Metal-Metal Bonding. V. Direct and Indirect Intermetallic Forces from the Vibrational Spectra and Analyses of $M_2Cl_9^{3-}$ (M = Cr, W) Ions, with R. J. Ziegler, *Inorg. Chem.* **11**, 2796 (1972).
20. Spectroscopic Studies of Metal-Metal Bonding. IV. Absorption and Laser Raman Spectra and Vibrational Analyses of $[(OC)_5Mn- M'(CO)_5^-]$ (M' = Cr, Mo, W), with J. R. Johnson and R. J. Ziegler, *Inorg. Chem.* **12**, 2349 (1973).
21. Vibrational Spectral Study of Molecular Orientation in Vitreous Fibers, with P. J. Miller and G. J. Exarhos, *J. Chem. Phys.* **59**, 2696 (1973).
22. Interionic Vibrations and Glass Transitions in Ionic Oxide Metaphosphate Glasses, with G. J. Exarhos and P. J. Miller, *J. Chem. Phys.* **60**, 4145 (1974).

23. Spectroscopic Studies of Metal-Metal Bonding. VI. Vibrational Spectra and Analyses of $X_3MFe(CO)_4$. (X = Cl, Br; M = Ge, Sn), with W. M. Butler and W. A. McAllister, *Inorg. Chem.* **13**, 1707 (1974).
24. Raman Study of Isothermal Devitrification Kinetics of $(NaPO_3)_{11}$, with G. J. Exarhos, *J. Amer. Ceram. Soc.* **57(9)**, 401 (1974).
25. Electron Delocalization Contribution to Single Crystal Thermal Expansion of a Polydiacetylene, with G. J. Exarhos and R. H. Baughman, *J. Polymer Sci.* **12**, 2189 (1974).
26. Spectroscopic Studies of Metal-Metal Bonding. VII. Absorption and Laser Raman Spectra and Vibrational Analyses of $[(OC)_5Re-M'(CO)_5]$ (M' = Cr, Mo, W), with J. R. Johnson and D. M. Duggan, *Inorg. Chem.* **14**, 1053 (1975).
27. Calculation of Ionic Conductivity Activation Energies in Ionic Oxide Glasses from Spectroscopic Data, with G. J. Exarhos and P. J. Miller, *Solid State Commun.* **17**, 29 (1975).
28. Resonance Raman Study of the Reversible Thermochromic Phase Transition of a Polydiacetylene, with G. J. Exarhos and R. H. Baughman, *J. Amer. Chem. Soc.* **98**, 481 (1976).
29. A Laser Raman Study of the Stress Dependence of Vibrational Frequencies of a Monocrystalline Polydiacetylene, with V. K. Mitra and R. H. Baughman, *J. Chem. Phys.* **66**, 2731 (1977).
30. The Composition Dependence of Glass Transition Properties, with J. M. Gordon, G. B. Rouse, and J. H. Gibbs, *J. Chem. Phys.* **66**, 4971 (1977).
31. NMR and Infrared Study of Cation Motion in Vitreous and Polycrystalline $TiPO_3$ with L. W. Panek, G. J. Exarhos, and P. J. Bray, *J. Non-cryst. Solids*, **24**, 51 (1977).
32. Ion Motion and the Mixed Alkali Effect, with G. B. Rouse and J. M. Gordon, *J. Non-cryst. Solids*, **473** (1977).
33. Mixed Alkali Glass Spectra and Structure, with G. B. Rouse and P. J. Miller, *J. Non-cryst. Solids*, **28**, 193 (1978).
34. Far-Infrared Study of Cation Motion in Dry and Solvated Mono- and Divalent Cation Containing Zeolites X and Y, with W. M. Butler, C. L. Angell and W. A. McAllister, *J. Phys. Chem.*, **81**, 2061 (1977).

35. Far Infrared Studies of Ion Clustering in Ionomers, with G. B. Rouse, A. T. Tsatsas, and A. Eisenberg, *J. Polym. Sci.*, **17**, 81 (1979).
36. Sample Modulated Raman Spectroscopy and Frequency Modulated Visible Light: Resonance Raman Spectrum of a Polydiacetylene Fiber, with C. Tzinis, S. Bahl, P. Davidson, and R. H. Baughman, *Rev. Sci. Inst.*, **49**, 1725 (1978).
37. The Mixed Alkali Effect: Theoretical Considerations, with G. B. Rouse, and J. M. Gordon, *J. Non-cryst. Solids*, **33**, 83 (1979).
38. An Electrochemical Heat Engine for Direct Solar Energy Conversion, with R. Hammond, *J. Solar Energy*, **23**, 443 (1979).
39. Infrared Studies of Ionomer Clustering, with G. B. Rouse and A. T. Tsatsas, *Chimika Chronika* **8**, 45 (1979).
40. Comparative Raman Study of Mixed-Alkali and Similar Ion Exchanged Glasses, with C. Windisch, *J. Non-cryst. Solids*, **44**, 345 (1981).
41. Formation of Bridged Group IVB Metal to Group VIII Metal Polymers, with J. A. Abys and G. Ogar, *Inorg. Chem.* **20**, No. 12 (1981).
42. Preparation of O¹⁷-Labelled Glasses and Glass Precursors, with J. A. Abys, D. M. Barnes, S. Feller, and G. Rouse, *Materials Sci. Bulletin*, **15**, 1581 (1980).
43. Formation of Hafnium-Transition Metal \square Bond; Synthesis of (⁵C₅H₅)₂HfFe(CO)₄ via Nucleophilic Displacement, with J. A. Abys, *J. Organometallic Chem.*, **204**, C5 (1981).
44. Brillouin Spectra of the Mixed Alkali Glasses xCs₂O(1-x)Na₂O•5SiO₂, with G. B. Rouse and E. I. Kamitsos, *J. Non-cryst. Solids* **45**, 257 (1981).
45. Raman Spectroscopic Study of Molecular Orientation in Vitreous B₂O₃, with C. F. Windisch, *J. Non-cryst. Solids*, **48**, 325 (1982).
46. Vibrational Spectra of Oxygen- and Boron-Isotopically Substituted B₂O₃ Glasses, with C. F. Windisch, *J. Non-cryst. Solids*, **48**, 307 (1982).
47. Raman Study of the Mechanism of Electrical Switching in CuTCNQ Films, with E. I. Kamitsos and C. H. Tzinis, *Solid State Commun.*, **42**, 561 (1982).

48. Optically Induced Transformations of Metal TCNQ Materials, with E. I. Kamitsos, Solid State Commun. **45**, 165 (1983).
49. Raman Studies in CuTCNQ. Frequency and Resonance Raman Intensity Calculations in TCNQ Ion-Radicals, with E. I. Kamitsos, J. Chem. Phys., **79**, 5808 (1983).
50. A Raman Investigation of Cadmium Borate and Borogermanate Glasses, with G. D. Chryssikos and E. I. Kamitsos, J. Non-cryst. Solids, **93**, 155 (1987).
51. Raman Spectroscopic Study of Molecular Orientation in AgTCNQ Thin Films, with E. I. Kamitsos, J. Chem. Phys., **79**, 477 (1983).
52. Vibrational Spectra of Single and Mixed Alkali Pentasilicate Glasses, with E. I. Kamitsos, J. Non-cryst Solids, **65**, 333 (1984).
53. Synthesis and Spectral Study of Low Dimensional Poly-yne Polymers Containing Phthalocyanine Silicon and Dimethyl Silicon in the Polymer Backbone, with Il Wun Shim, J. Organometallic Chem, **260**, 171 (1984).
54. A Far Infrared Study of Ionic Interactions in Polystyrene Sulfonic Acid Ionomers, with V. D. Mattera, Jr., J. Polymer Sci., **22**, 67, (1984).
55. The Chemistry of Metals in Ionomers: Reactions of Rhodium-PSSA with CO, H₂ and H₂O, with Vincent D. Mattera, Jr., Inorganic Chem., **23**, 3597 (1984).
56. Raman Study of Lithium Fluoride Containing Fast Ionic Conducting Glasses, D.E. Trucotte, E.I. Kamitsos and W.M. Risen, Jr., Solid State Commun. **51**, 313 (1984).
57. Observation of Glass-Like Behavior in Conjugated Polymer Molecules, J.Y. Ha, R.M. Stratt and W.M. Risen, Jr., J. Chem. Phys., **81**, 2855 (1984).
58. The Chemistry of Ruthenium in PSSA Ionomers, I.W. Shim, V.D. Mattera, Jr., and W.M. Risen, Jr., J. Catalysis, **94**, 531 (1985).
59. Composition Dependence of Glass Transition Temperature in PSSA Ionomers, V.D. Mattera, Jr. and W.M. Risen, Jr., J. Polym. Sci. (Polym. Physics), **24**, 753 (1986).
60. The Pt(C₆H₁₁)₃(C₂H₄)₂ Mediated Activation of Aldehyde C-H Bonds *via* Chelate-Assisted Oxidative Addition Reactions, J.J. Koh, W.H. Lee, P.G. Williard and W.M. Risen, Jr., J. Organomet. Chem. **284** (1985).
61. Spectroscopic and Thermal Studies of Ionic Interactions in Ionomers, V.D. Mattera, Jr., S.L. Peluso, A.T. Tsatsas and W.M. Risen, Jr., Chapter in **Coulombic Interactions in Polymers**, A.C.S. Sympsoium Series No. 22x, American Chemical Society,

Washington,D.C., 1984.

62. Chemistry in Ionomers, D.M. Barnes, G.D. Chryssikos, V.D. Mattera, Jr. S.L. Peluso, I.W. Shim and W.M. Risen, Jr., Chapter in **Coulombic Interactions in Polymers**, A.C.S. Symposium Series No. 302, American Chemical Society, Washington, D.C., 1984.
63. Synthesis and Study of N,N-Dimethyl-Benzyl and Diphenylphosphinobenzyl Compounds of Early Transition Metal Metallocenes and Their M(III) Derivatives, J.J. Koh, P.H. Rieger, I.W. Shim and W.M. Risen, Jr., Inorganic Chemistry, **14**, 2312 (1985).
64. Oxygen Adsorption on Silver in PFSA Films, G. Chryssikos, V.D. Mattera, Jr., A.T. Tsatsas and W.M. Risen, Jr., J. Catalysis, **93**, 430 (1985).
65. Optical Spectra of Glasses, W.M. Risen, Jr., J. Non-cryst. Solids, **76**, 97 (1985).
66. Time Domain Measurements of Conducting Glasses, with D.E. Turcotte, G.D. Chryssikos, J.P. Perl, P. Winsor, and R.H. Cole, J. Chem. Phys., **84**, 6518 (1986).
67. An NMR Study of the Photoconducting Glass Systems CdO-B₂O₃-GeO₂ and CdO-B₂O₃-SiO₂, with R.V. Mulkern, S.J. Chung, P.J. Bray, G.D. Chryssikos, and D.E. Turcotte, J. Non-cryst. Solids, **85**, 69 (1986).
68. Infrared Spectroscopic Study of Cadmium Borogermanate Glasses, with G.D. Chryssikos, D.E. Turcotte, R.V. Mulkern and P.J. Bray, J. Non-cryst. Solids, **85**, 54 (1986).
69. A Kinetic Study of the Catalytic Oxidation of CO over PFSA (NAFION) Supported Rhodium, Ruthenium and Platinum, with V.D. Mattera, Jr., D.M. Barnes, S.N. Chaudhuri, and R.D. Gonzalez, J. Phys. Chem, **90**, 4819 (1986).
70. Optical and Vibrational Properties and the Crystal Structure of Molecular Complexes: Biphenyl-TCNQ and *p* Terphenyl-TCNQ., with E.I. Kamitsos, V.D. Mattera, and W.T. Robinson, J. Molec. Struc., **143**, 211 (1986).
71. Spectroscopic Investigations of Transformation Phenomena Exhibited by Metal-TCNQ Materials, with E.I. Kamitsos, Molec. Crystal Liq. Cryst., **134**, 31 (1986).
72. Chemistry In Ionomers, NATO - ARW, D. Reidel Publ. (1986).
73. Rare Earth Phosphate Glasses, with K. Sun, Solid State Commun. **60**, 697 (1986).
74. Thermally Stimulated Discharge Current Analysis of Polystyrenesulfonic Acids, with Q. Gu, W. Ye, Wang and K. Sun, Solid State Commun., **63**, 881 (1987).
75. Observation of Molecular Vibrations in Real Time, with J. Tauc, H. Maris, C. Thomsen, W. Vardeny and J. M. Ha, Phys. Rev. Letters, **57**, 3302 (1986).

76. Sol-gel Preparation of Rare Earth Silicate Glasses, with K. Sun and W. H. Lee, *J. Non-cryst. Solids*, **92**, 145 (1987).
77. Actinide Silicate Binary Glasses: Low Temperature Sol-Gel Preparation of Uranium and Thorium Silicate Glasses, with W. H. Lee and K. Sun, *J. Non-cryst. Solids*, **104**, 123 (1988).
78. Time Domain Reflectometry Study of Fast Ionic Conducting Glasses, with G. D. Chryssikos, A. Burns, R. H. Cole and W. M. Risen, Jr., *J. Chem. Phys.*, **89**, 612 (1988).
79. Synthesis and Optically Induced Transformation of Metal TCNQF_4 Thin Films, with A. M. Kotsiliou, *Solid State Comm.*, **68**, 503 (1988).
80. Dielectric Spectra of Ionic Conducting Oxide Glasses to 2 GHz, with A. Burns, G. D. Chryssikos, E. Tombari and R. H. Cole, *J. Physics and Chem. Glasses*, **30**, 264 (1989).
81. Dielectric and Infrared Reflectance Studies of Inorganic Oxide Glasses, with A. Burns and H. P. Brack, *J. Non-cryst Solids*, **131-133**, 994 (1991).
82. Chitaline Materials: Soluble Chitosan-Polyaniline Copolymers and their Conductive Doped Films, with S. Yang, A. Burns, S. Tirmizi and A. Barney, *Synthetic Metals*, **32**, 191 (1989).
83. Preparation and Thermal Characterization of the Glass Transition Temperatures of Sulfonated Polystyrene - Metal Ionomers, with S. Yang and K. Sun, *J. Polym. Sci. - Polym Physics*, **28**, 1685 (1990).
84. Effect of Sulfonation on Physical Properties of Ionic Polymers, with S. Yang, in "Properties of Ionic Polymers - Natural and Synthetic", Ed. L. Salmen and M. Htun, STFI, Stockholm, 1990.
85. Aerosol Techniques for Glass Formation, with T. F. Morse, A. Kilian, L. Reinhart and J. W. Cipolla, *J. Non-crystalline Solids*, **129**, 93 (1991).
86. Low Temperature Ion-Exchange of Dried Gels for Potential Waveguide Fabrication in Glasses, with T. F. Morse and G. Tsagaropoulos, *Proc. S. P. I. E.* 6; 1590 (1991).
87. Fourier Transform Mid- and Far Infrared IR Specular Reflectance Study of Oxidized and Exchanged Polyethylene Surfaces, with H. P. Brack, *Polymer Preprints*, **32** (3), 653 (1991).
88. Spectroscopic Analysis of an Eu-doped Aluminosilicate Optical Fiber Preform with Kyunghwan Oh, with T. F. Morse, L. Reinhart and A. Kilian, *J. Non-crystalline Solids*, **149**, 229 (1992).
89. Studies on Solution-cast Perfluorocarbonsulfonic Acid Ionomers, with A. T. Tsatsas, *J.*

Polym. Sci. (Polym. Physics) **31**, 1223 (1993).

90. Energetics of the Sol-Gel-Glass Transformation in Sodium Silicate Gels, with S. Yang and G. Tsagaropoulos, J. Non-cryst. Solids, **169**, 267 (1994).

91. Molecular Interpretation of Miscibility of Polyamide - 6 with Sulfonated Polystyrene Ionomers, with P. Rajagopalan, H. P. Brack, A. Eisenberg and J. Kim, J. Polym. Sci., Part B: Polymer Physics, **33**, 495 (1995).

92. A Spectroscopic and Viscometric Study of the Metal Ion-induced Gelation of the Biopolymer Chitosan, with H. P. Brack and S. A. Tirmizi, Polymer, **38**, 2351 (1997)

93. Synthesis and Near Infrared Properties of Rare Earth Ionomers, with P. Rajagopalan, A.T. Tsatsas, J. Polymer Sci., B. Polymer Physics **34**, 151 (1996).

94. W. M. Risen, Jr., Applications of Ionomers, Physical Chemistry of Ionomers, S. Schlick, Ed., CRC Press, Boca Raton, FL, 1996.

95. Morphology of Samarium Neutralized Ethylene Ionomers, with A. Biswas and P. Rajagopalan, Polym. **37**, 1 (1996).

96. Spectral Studies of Novel Lanthanide-containing Polymers by Near Infrared and FT-Raman Spectroscopy with P. Rajagopalan, Y. Z. Wang, and G. Tsagaropoulos, Journal of Molecular Structure, **404**, 59 (1997).

97. Fourier Transform Mid- and Far-infrared Specular Reflectance Studies of the Polarizability of Ion-containing Polymers and Oxidized Polyethylene and its Application to Adhesion, with H. P. Brack, J. Materials Sci. **7**(12), 2355 (1997)

98. Synthesis and Properties of Optically Active Polyurethane Ionomers Containing Erbium, with Quan Gu, Poly. Prepr. **40**, 1302 (1999)

99. Chemical Interactions in Ionomers and Ionomer Membranes Containing Metal Particles and Ions, New Materials for Batteries and Fuel Cells; Mat. Res. Soc. Symp. Proc. Vol. **575**, 201 (2000).

100. Transparent Monolithic Metal Ion Containing Nanophase Aerogels, with Xiangjun Hu, Shuang Ji, and Kenneth Littrell, Nanophase and Nanocomposite Materials; Mat. Res. Soc. Symp. Proc. Vol **581**, 353 (2000).

101. Synthesis and Properties of Optically Active Polyurethane Ionomers Containing Erbium, Chapter 3, pp 35-48 in "Optical Polymers; Fibers and Waveguides", Ed. J. P. Harmon and G. K. Noren, ACS Symposium Series 795, American Chemical Society, Washington, DC, 2001

102. Electrical and Chemical Modifications of Nafion Membrane Near Surface Regions, with Pu Zhang, *Poly. Prepr.* **42**(2),548 (2001)
103. Characterization of Silica-polymer aerogel composites by small-angle neutron scattering and transmission electron microscopy, with Xiangjun Hu, Kenneth Littrel, Shuang Ji, D. G. Pickles, *J. Non-cryst. Solids*, **288**, 184 (2001)
104. Biopolymer-silica Hybrid Aerogels Containing Transition Metal Species; Structure, Properties and Reactions, with X. Hu and S. Ji , Materials Research Society Symposium Series, Vol. 702, 65 (2002)
105. A New Hybrid Aerogel Approach to Modification of Biderived Polymers for Materials Applications, with Mingzhe Wang and Xipeng Liu, Materials Research Society Symposium Society, Vol. 702, 77 (2002)
106. Polymer-Attached Functional Inorganic-Organic Hybrid Nano-composite Aerogels, with Xipeng Liu and Mingzhe Wang, *Mat. Res. Soc. Symp. Proc.*, Vol 740, I12.24.1 (2003)
107. Photo-formed Metal Nanoparticle Arrays in Monolithic Silica-Biopolymer Aerogels, with Xipeng Liu, Yu Zhu and Chunhua Yao, *Mater. Res. Symp. Proc.* Vol. 788,13-24 (2003)
108. Chitosan biopolymer-silica hybrid aerogels, with Xipeng Liu, in "Natural Fibers, Plastics and Composites", Ed. F. T. Wallenberger and N. E. Weston, Kluwer Academic Publishers, Boston, MA, Chapter 13, pp 227-246 (2004).
109. Formation and Reaction of Metal-containing Nanoparticles in Organic/Inorganic Hybrid Aerogels, with Chunhua Yao, Materials Research Society Symposium on Continuous Nanophase and Nanostructured Materials, *MRS Symp. Proc.* (2005), Vol. Date 2004, 847, 515-520.
110. Novel Ferromagnetic Aerogel Composite Materials with Nanoparticle Formation and Chemistry in Response to Light, with Chunhua Yao and Xipeng Liu, *Mater. Res. Soc. Symp. Proc.* (2006), 888 (Materials and Devices for Smart Systems II), 131-136.
111. Chemically Selective Reactions in Confined Spaces in Hybrid Aerogels, with Xipeng Liu and Chunhua Yao, *Mater. Sci. Soc. Symp. Proc.* (2006) in pub.

Selected Other (Reviews, Articles and Joint Presentations):

1. Metal-Ligand and Related Vibrations: A critical Survey of the IR and Raman Spectra of

Metallic and Organometallic Compounds - Book Review, American Scientist, 298 (1968).

2. Conference on Photoionization Phenomena and Photoelectron Spectroscopy - Oxford, England, 1970 - Report, Appl. Opt. **10**, 357 (1971).
3. Vibrational Spectra and Structure of Silicates - Book Review, Can. J. Spectry. **18**, 9A (1972).
4. Diffusion Monograph Series: Ionic Diffusion in Oxide Glasses - Book Review, Materials Research Bulletin, 1975.
5. Advances in Inorganic Chemistry and Radiochemistry, Vol. 28., Book Review, J. Amer. Chem. Soc., 1985.
6. Impacts on Universities, Chapter 13 of *New Federal Policies for R&D*, Proceedings National Conference on The Advancement of Research, University Press of America, 1985.
7. NSF 1987 Budget, A.C.S. Position; Testimony before the House Appropriations Subcommittee on HUD and Independent Agencies, 1986.
8. Chemical, Biological and Industrial Applications of Infrared Spectroscopy - Book Review, J. Amer. Chem. Soc., 1987.
9. Fourier Transform Mid- and Far- Infrared Specular Reflectance Studies of Ion-Containing Polymers: Dielectric Properties and Application to Adhesion, by H. P. Brack and W. M. Risen, Jr.,
Symposium on Recent Developments in Polymer and Surface Science, Institut de Chimie de l'Université de Neuchatel, Switzerland, November, 1993.
10. Gelation Reactions of Chitosan with Platinum(II): Kinetic Model and Applications to Bond Percolation Theory by H. P. Brack and W. M. Risen, Jr.,
Symposium on Physics of Complex Fluids, Swiss Physical Society, University of Berne, Switzerland, March, 1994.
11. A Spectroscopic and Viscometric Study of the Metal on Induced Gelation of the Biopolymer Chitosan by H. P. Brack, S. A. Tirmizi and W. M. Risen, Jr., Jahrestagung der Fachgruppe Rheologie der Polymer-Gruppe der Schweiz, ETH-Zurich, April 15, 1994, presentation HPB.
12. Synthesis and Spectroscopic Properties of Rare Earth Ionomers, with Padmavathy Rajagopalan, Gordon Conference on Ion-Containing Polymers, July, 1995.
13. Novel Optically Active Polyurethane Ionomers,

with Quan Gu, Gordon Research Conference on Ion-containing Polymers, Newport, RI, June, 1999.

14. Structural Studies of Nanophase Silica-Chitosan-Metal Aerogels, with Xiangjun Hu, Shuang Ji, David Pickles, and Kenneth Littrell, Materials Research Society, Boston, MA, Nov. 1999
15. Catalytic Studies of Nanophase Silica-Chitosan Aerogels Containing Rhodium or Ruthenium Ions, with Shuang Ji, Xiangjun Hu, and Richard Gonzalez, Materials Research Society, Boston, MA, Nov. 1999.
16. Optically Active Lanthanide-containing Polyurethane Ionomers, with Quan Gu, Materials Research Society, Boston, MA, Nov. 1999.
17. Characterization of Silica-Biopolymer Aerogel Composites by Small Angle Neutron Scattering (SANS) and Transmission Electron Microscopy, Materials Research Society, Boston, MA, Nov. 2000.
18. Transition Metal-Containing Silicate Glasses From Silica Gel and Carboxylated Silicone Precursors, 34th Organosilicon Symposium, White Plains, New York, May, 2001 (Mingzhe Wang)
19. Modification of Ionomer Membranes for Fuel Cell Applications, Gordon Research Conference, Ion-Containing Polymers, July, 2001 (with Pu Zhong)
20. Electrical and Chemical Modifications of Nafion Membrane Near Surface Regions, American Chemical Society National Meeting, Chicago, IL, August, 2001 (with Pu Zhang)
21. A New Hybrid Aerogel Approach to Modification of Bioderived Polymers for Materials Applications, Materials Research Society, Symposium on Advanced Fibers, Plastics and Composites, Boston, MA, November, 2001 (M. Z. Wang with X. Liu)
22. Synthesis and Characterization of Germanium-Containing Silicone Compounds and Glass Films Formed From Them, 34th Organosilicon Symposium, New York, May, 2001
23. Polymer-attached Functional Inorganic-Organic Hybrid Nano-composite Aerogels, Materials Research Society, Symposium on Nanomaterials, December, 2002.

24. Electrical and Chemical Modification of the Near Surface Region of PFSA (Nafion) Membranes for Fuel Cell Applications, American Chemical Society Symposium on Advanced Materials for Proton Electrolyte Membrane Fuel Cell Systems, Asilomar, CA, February, 2003 (with Pu Zhang)

25. Electrochemical Modifications of Proton-Conducting Membranes for Fuel Cell Applications, Symposium on Fuel Cells, The Electrochemical Society, Orlando, FL, October, 2003 (with Pu Zhang and Liang Chen)

26. Photo-formed Metal Nanoparticle Arrays in Monolithic Silica-Biopolymer Aerogels, Symposium on Continuous Nanophase and Nanostructured Materials, Materials Research Society, Boston, MA, December, 2003 (with Xipeng Liu, Yu Zhu and Chunhua Yao).

27. Aerogel-controlled reaction to form gold nanoparticles by amino acid reduction, American Chemical Society National Meeting, Philadelphia, PA, August, 2004 (with Xipeng Liu).

28. Formation and Reaction of Metal-containing Nanoparticles in Organic/Inorganic Hybrid Aerogels, Symposium on Continuous Nanophase and Nanostructured Materials, Materials Research Society, Boston, MA, November, 2004 (with Chunhua Yao).

29. Replication of carbohydrates into hierarchically-structured ceramics, with Yongsoon Shin, Chunhua Yao, Chongmin Wang and Gregory Exarhos, American Chemical Society Meeting, Atlanta, GA March, 2006.

30. Controlled formation of colloidal carbon spheres with core-shell structures from cellulose, with Yongsoon Shin, Chuunhua Yao and Gregory J. Exarhos, American Chemical Society Meeting, Atlanta, GA, 2006.

Text Books:

Problems for General and Environmental Chemistry, With G. P. Flynn, Appleton-Century-Crofts, New York, N.Y.1972.

Principles and Explorations in the Chemical Laboratory, with J. C. Baird, Wadsworth Publishing, 1971.

Patents

Patents related to research at Brown University

Processing of Metallic-Charge Transfer Salts, W. M. Risen, Jr. and E. I. Kamitsos, U. S. Patent 4,613,553

Holographic Devices Employing Metallic Charge Transfer Salts, W. M. Risen, Jr. and E. I. Kamitsos, U. S. Patent 4,727,007

Methods and Compositions for Joining Waveguide Structures and the Resulting Joined Products. W. M. Risen, Jr. and Y. Z. Wang. U.S. Patent 6,143,108

Germanosiloxane Materials and Optical Components Comprising the Same. W. M. Risen, Jr., Y. Z. Wang and A. Honore. U. S. Patent 6,248,852 B1

Methods and Compositions for Producing Microlenses and Optical Filters. W. M. Risen, Jr. and Y. Z. Wang. U. S. Patent 6,294,217 B1

Aerogel Materials and Detectors, Liquid and Gas Absorbing Objects, and Optical Devices Comprising Same, W. M. Risen, Jr., R. Zhang, X. Hu, and S. Ji. U. S. Patent 6,303,046 B1

Methods and Compositions for Forming Silica, Germanosilicate and Metal Silicate Films, Patterns, and Multilayers. W. M. Risen, Jr., Y. Z. Wong and S. Bredall. U.S. Patent 6,319,551

Printing Medium Comprising Aerogel Materials, W. M. Risen, Jr., R. Zhang, X. Hu and S. Ji, US Patent 6,602,336

Polyurethane ionomer blends and methods for their preparation and formation, W. M. Risen, Jr. and Mingzhe Wang, US Patent 6,949,604

Polyurethane ionomers and methods for their preparation and formation, W. M. Risen, Jr. and Mingzhe Wang, US Patent 6,958,380

Printing Media Comprising aerogel materials, W. M. Risen, Jr., R. Zhang, X. Hu, and S. Ji. U.S. Patent 7,037,355

Printing Media Comprising aerogel materials, W. M. Risen, Jr., R. Zhang, X. Hu, and S. Ji. Patent 7,147,701

Patents not related to research at Brown University: 24

SELECTED INVITED LECTURES (1979 - 2006)

Polydiacetylenes

Northwestern University, Chemistry Lectures - 1979

Polydiacetylenes, Strain Dependence and Sample Modulated Raman Spectroscopy
Eastern Analytical Symposium, New York City, 1979

Polydiacetylenes and Frequency Modulated Visible Light

McDonnell Douglas Corporation, St. Louis, Missouri, 1979

Polydiacetylenes; and Vibrational Spectroscopy of Glasses;
Athens University, Athens, Greece - 2 Lectures, 1979

Chemical Research (CCR)

Industrial Research Institute (IRI), Washington, D.C., 1980

Chemistry in Ionomers,

Polytechnic Institute of N. Y., 1981

Chemistry in Ionomers and Ion Motion in Amorphous Materials,

IUPAC Meeting Macro 82, (Chairman and Invited Lecturer),
Amherst, MA., 1982

Chemistry in Perfluorinated Ionomer Membranes,

American Chemical Society Symposium, Buena Vista, Florida, 1982

Ion Motion and Structure in Ionic Oxide Glasses,

International Symposium on Structure and Bonding in
Noncrystalline Solids , Washington, DC., May 1983

Gordon Research Conference on Ion-containing Polymers ,

Invited Lecturer, 1983

Relaxation Phenomena in Glasses (Series of Lectures)

Virginia Polytechnic Institute and State University, July 1983

Studies on Inorganic Glasses,

University of Rhode Island,
Chemistry Colloquium, October 1983

Federal Research Funding Policy; A Faculty Perspective,

National Conference on Advanced Research and
The Government-University-Industry Roundtable of
The National Academy of Science,
Williamsburg, Virginia, October, 1984

Chemistry in Ionomers,

American Chemical Society Conference on Polymers,
American Chemical Society Meeting,
Philadelphia, Pennsylvania, August 1984

Spectroscopic and Thermal Studies of Ionic Interactions in Ionomers,

American Chemical Society Conference on Polymers, American
Chemical Society Meeting, Philadelphia, Pennsylvania, August, 1984

Spectroscopic Studies of Metal TCNQ Films,
LTV Corporation, Dallas, Texas, June, 1984

Optical Spectra of Glasses,
Argonne National Laboratory,
Chicago, Illinois, May, 1985

Phenomena Exhibited by Polydiacetylenes in Solution,
American Chemical Society Symposium on Relaxation Processes,
American Chemical Society Meeting, Miami, Florida, April, 1985

Spectral and Dielectric Studies of Glasses,
Princeton University, Princeton, NJ, May 1986

Chemistry in Ionomers,
NATO Advanced Study Summer Institute,
Grenoble, France, June 1986

Spectroscopic and Dielectric Studies of Ionic Oxide Glasses,
Lecture sponsored jointly by:
Harvard University and
Massachusetts Institute of Technology, March, 1987

Relaxation Kinetics of Polydiacetylene Solutions,
University of Rhode Island, April, 1987

Characterization of Rare Earth Polystyrenesulfonate Ionomers,
Symposium on Chemical Characterization of Polymers,
American Chemical Society, Denver Colorado, April, 1987

Chemistry in Ionomers,
Gordon Research Conference on Ion Containing Polymers
August, 1987

Chemistry in Ionomers,
European Society of Membrane Science,
4th European Summer School in Membrane Science:
Conference on Ions in Membranes,
Chester, England, September, 1987

Chemistry in Ionomers,
Symposium on Polymers Reactive in a
Chemical Environment, Durham, North Carolina, March 1989

Effect of Sulfonation on the Physical Properties of Ionic Polymers,

Workshop on the Properties of Natural and Synthetic Ionic Polymers,
STFI (Swedish Pulp and Paper Institute) and Swedish Royal Institute,
Stockholm, Sweden, August, 1989

Chemistry and Catalysis in Metal Ionomers Systems,
University of Connecticut, Storrs, Connecticut, March 1990

Issues Concerning Chemical Warfare Control,
Brown Nuclear Education Project, March 1990

Teaching Science: Humane or Arcane? Plenary Session,
Center for the Advancement of College Teaching, Brown University, March 1990

Ions in Sol-Gel Prepared Amorphous Materials,
Gordon Research Conference on Solid State Ionics, June 1990

Dielectric and Infrared Reflectance Studies of Inorganic Oxide Glasses;
International Meeting on Relaxation in Complex Systems;
Solid State Ionics, Heraklion, Crete, Greece, June 1990

Formation Reactions with Natural and Synthetic Ionomers;
IUPAC International Symposium on Macromolecules,
Montreal, Canada, July 1990

Metal-Containing Inorganic Gels and Glasses,
Brookhaven National Laboratory,
Brookhaven, New York, April, 1991

Low Temperature Ion-Exchange of Dried Gels for Potential Waveguide
Fabrication in Glasses,
Symposium on Submolecular Chemistry and Physics of Glasses, SPIE,
Boston, MA, September, 1991

Fourier Transform Mid- and Far Infrared IR Specular Reflectance Study
of Oxidized and Exchanged Polyethylene Surfaces,
Symposium on Optical Methods of Polymer Characterization,
American Chemical Society, New York, NY, August, 1991

Metal Ions and Gelation in Chitosan- and Carragenan- Containing
Systems,
Wesleyan University, October, 1991

Metal Ions and Gelation in Chitosan - and Carragenan - Containing
Systems,
Laval University, Quebec City, Quebec, November, 1991

Spectroscopic and Thermal Studies of Glasses,
McGill University, Montreal, Canada, November, 1991

Studies of Ion-Containing Polymers,
McGill University, Montreal, Canada, November, 1991

Metal Ions and Gelation in Chitosan - and Carragenan - Containing Systems.,
McGill University, Montreal, Canada, December, 1991

Spectroscopic and Thermal Studies of Glasses,
Sullivan Research Center,
Corning Glass Works, Corning, NY, April 1992

New Horizons in Ionomer Chemistry,
American Chemical Society: Special Conference on Polymers,
Monterey CA, May, 1992

Novel Lanthanide - Containing Ionomers,
Gordon Research Conference, July, 1993

Gelation in Chitosan - Metal Ion Systems,
The Dow Lecture in Polymer Science,
University of Detroit - Mercy
Detroit MI, February, 1994

Energetics of the Gel to Glass Transformation in Silicate and Ionomeric Systems,
Armstrong World Industries, Central Research Laboratories,
Lancaster, PA, February, 1994

Energetics of the Gel to Glass Transformation in Sodium Silicate Gels,
Symposium on the Structure and Properties of Non- Crystalline Materials,
American Physical Society, Pittsburgh, PA, March 1994

Structural and Chemical Transformations in Silicon-Containing Polymers and Gels,
Fourth International Symposium on Polymer Electrolytes,
Newport, RI, June, 1994

Chemical and Physical Studies of Gels and Glasses,
Pacific Northwest Laboratory,
Battelle, NW, Richland WA., July, 1994

Structural and Chemical Transformations In Silicon-Containing Gels,

AT&T Bell Laboratories, Murray Hill NJ, September 9, 1994

Synthesis and Optical Properties of Lanthanide Ionomers and Silicate Glasses,

Chung-Ang University, Korea, May 15, 1995

Sol-Gel to Glass Transformations in Silicate Systems,

Korean Institute of Science and Technology,
Seoul, Korea, May 16, 1995

Gelation of Chitosan by Transition Metals: A Kinetic Study of the Pt(II) Chitosan System,

Korea University, May 17, 1995

Sol-Gel Based Glass Systems, Invited Discussion,

SamSung Electronics Corp., Central Research Laboratory
Seoul, Korea, May 23, 1995

Ionomers: An Overview of Structure and Properties,

Central Research Laboratories,
Armstrong World Industries, Lancaster , PA, April 28, 1995

Spectral Studies of Novel Lanthanide-containing Polymers and glasses,

Symposium on Modern Spectroscopy in Inorganic Chemistry,
PacificChem, Honolulu, Hawaii, December 21, 1995

Gel Formation and Transformation Phenomena in Inorganic Systems

Georgetown University, Washington, DC, March 1996

Novel Ionomer Chemistry,

University of Science and Technology of China,
Hefei, China, October, 1996

Macroscopic and Molecular Level Studies of Gelation in Metal-Chitosan Systems

University of Science and Technology of China
Hefei, China, October, 1996

Kinetics and Mechanism of the Pt(II) and Pd(II) Induced Gelation of Chitosan

Nanjing University, Nanjing, China, October, 1996

Syntheses of Novel Siloxane and Germanosiloxane Ionomers and Glasses

Research and Development Laboratories, Corning Incorporated,
Sullivan Park, Corning, NY, September 26, 1996

Sol-Gel Chemistry in Organic, Inorganic and Modified Biopolymeric Systems

Research and Development Invited Lecture Series
Arkwright, Inc. W. Warwick, RI, October, 1996

Novel Materials for Imaging

Symposium on Imaging Science and Technology,
Providence, RI, May 14, 1997

Siloxane and Germanosiloxane Ionomers

Plenary Lecture, Japanese Polymer Society Meeting,
Gifu, Nagoya, Japan, July 1, 1997

Lanthanide Containing Organic and Inorganic Ionomers,

Gifu University, Gifu, Japan, July 10, 1997

Germanosiloxane and Metal Germanosiloxane Polymers and Glasses,

Asahi Glass Co., Central Research Laboratories, Yokohoma, Japan,
co-sponsored by Aoyama Gakuin University and IIS (Tokyo) Japan, July 16, 1997

Germanosiloxane and Metal Germanosiloxane Polymers and Glasses,

Ritsumeikan University, Kyoto, Japan, July 14, 1997

Lanthanide Containing Siloxane and Germanosiloxane Polymers and Glasses, Fujikura,
Ltd., Sakura, Chiba (Tokyo), Japan, July 17, 1997

Synthesis and Study of Siloxane and Germanosiloxane Ionomers,

Clark University, Worcester, Massachusetts, September 15, 1997

Vibrational Spectroscopy of Novel Aerogel Materials,

Spectroscopy Society of Canada, Kingston, Ontario, Canada, August 10, 1998

Transparent Monolithic Nanostructural Composites Containing Transition Metals in
Organic/Inorganic Aerogels,

Symposium on Nanostructures and Composites, American Chemical Society National
Meeting, August 26, 1998, Boston, MA

Perspectives on Chemistry in Ionomers: Metal-Containing Ionomers,

Seminar Series: Electrochemistry, Catalysis and General Energy Division,
Paul Scherrer Institute, Villigen, Switzerland, October 22, 1998.

Transparent Monolithic Nanostructural Organic-Inorganic Aerogels Containing
Transition Metals and Their Reactions with CO, NO and H₂,

Eidgenosssische Technische Hochschule, Zurich (ETH-Z), Zurich, Switzerland November
3, 1998.

Transparent Monolithic Aerogels Containing Transition Metals and Their Reactions with H₂, D₂, CO and ¹³CO,
Universitat Bern, Bern, Switzerland, November 11, 1998.

Synthesis and Study of Siloxane and Germanosiloxane Ionomers and Microstructural Glasses Formed from Them,
Imperial College, University of London, London, England, UK, November 17, 1998.

Transparent Monolithic Nanostructural Organic-Inorganic Aerogels Containing Transition Metals and Reactions with CO, H₂ and NO,
Queen Mary and Westfield College, University of London, London, England, UK, November 17, 1998.

Transparent Nanostructural Organic-Inorganic Aerogels Containing Transition Metals and their Reactions,
McGill University, Montreal, Quebec, Canada, November 23, 1998.

Chemistry in Ionomers,
International Conference on Electroactive Membranes,
ETH Conference Center, Monte Verita, Ascona, Switzerland, February 16, 1999.

Chemical Interactions in Ionomers and Ionomer Membranes Containing Metal Particles and Ions,
Symposium on New Materials For Fuel Cells,
Materials Research Society, San Francisco, CA, April, 1999.

Synthesis and Properties of Optically Active Polyurethane Ionomers Containing Erbium,
Symposium on Optical Polymers: Advances in Optical Fibers and Waveguides,
American Chemical Society New Orleans, LA, August, 1999.

Lanthanide Containing Optically Active Polyurethane Ionomers, Polymer Science Lectureship, Univ. of Southern Mississippi, September 22, 1999.

Transparent Monolithic Transition Metal Ion Containing Nanophase Aerogels,
Department of Chemistry, Tougaloo College, Tougaloo, MS, September 23, 1999.

Transparent Monolithic Transition Metal Ion Containing Nanophase Aerogels,
Symposium on Nanostructures and Nanocomposites,
Materials Research Society, Boston, MA, November, 1999.

Synthesis, Structure and Reactions of Transparent Monolithic Transition Metal Ion Containing Nanophase Aerogels,
University of Central Michigan, April, 2000.

Transparent Monolithic Transition Metal Ion Containing Nanophase Aerogels and Their

Optical and Chemical Properties,
Lucent Technology, July, 2000.

Synthesis and Properties of Optically Active Carboxylated Polyurethanes and Their Rare Earth Ionomers,
A.C. S. Symposium "Polyurethanes 2000", Annapolis, MD, September, 2000.

Preparation, Characterization and Reactions of Transparent Transition Metal-Containing Aerogels,
Chemistry Department, Georgetown University, Washington, DC, April, 2001

Biopolymer-Silica Hybrid Aerogels Containing Transition Metal Species; Structure, Properties, Reactions, Materials Research Society, Symposium on Advanced Fibers, Plastics and Composites, Boston, MA November, 2001 (with X. Hu and S. Ji)

A Study of New Metal-Containing Polyurethane Anionomers Polyurethanes 2002 International Workshop, Annapolis, MD September, 2002

Novel Hybrid Aerogels Containing Bioderived Polymers and a New Approach to the Chemical Modification of These Polymers, Nagoya Institute of Technology, Nagoya, Japan, November 2002

Novel Hybrid Aerogels Containing Bioderived Polymers and a New Approach to the Chemical Modification of These Polymers,
Aoyama Gakuin University, Tokyo, Japan, November, 2002

Novel Hybrid Aerogels Containing Bioderived Polymers and a New Approach to the Chemical Modification of These Polymers,
Toa Gosei Co., Ltd., Kyoto, Japan, November 2002

Novel Hybrid Aerogels Containing Bioderived Polymers and a New Approach to the Chemical Modification of These Polymers,
Nippon Paint Co., Ltd., Nagoya, Japan, November 2002

Novel Polyurethane Ionomers, and A Study of their Physical and Chemical Properties.
Kyoto University, Kyoto, Japan, November 2002

Novel Polyurethane Ionomers, and A Study of their Physical and Chemical Properties.
Ritsumeikan University, Kyoto, Japan 2002

Novel Polyurethane Ionomers, and A Study of their Physical and Chemical Properties.
Mitsui DuPont Co., Ltd., Tokyo, Japan, November 2002

Physical and Chemical Modification of Proton Electrolyte Membranes
Tokyo Institute of Technology, Tokyo, Japan, November 2002

Physical and Chemical Modification of Proton Electrolyte Membranes
Toa Gosei Co. Ltd., Nagoya, Japan, November 2002

Physical and Chemical Modification of Proton Electrolyte Membranes
Gifu University, Gifu, Japan, November 2002

Physical and Chemical Modification of Proton Electrolyte Membranes
Kyoto University, Institute for Chemical Research, Kyoto, Japan, November, 2002

Electrical and Chemical Modifications of the Near Surface Region of
Perfluorocarbonsulfonic Acid Membranes For Fuel Cell Applications,
American Chemical Society Conference; Advances in Materials for Proton Membrane
Fuel Cell Systems, February 26, 2003, Asilomar, CA

Electrochemical Modifications of Proton-Conducting Membranes for Fuel Cell
Applications,
Symposium on Fuel Cells, The Electrochemical Society, Orlando, FL, October, 2003

Photo-formed Metal Nanoparticle Arrays in Monolithic Silica-Biopolymer Aerogels,
Symposium on Continuous Nanophase and Nanostructured Materials, Materials Research
Society, Boston, MA, December, 2003

Fuel Cell Membrane Modification and Chemistry,
Fuel Cell Meeting Organized by the British Consulate General for Science and
Technology for the United Kingdom Fuel Cell Mission, British Consulate, Cambridge,
MA, June 20, 2003

Chemically Functional Hybrid Aerogels,
U. S. Army Research Laboratory, Natick, MA, May 24, 2004.

Novel Aerogels; Formation and Reactions of Metal-containing Hybrid Aerogels, Central
Research Laboratory, Cabot Corporation, Boston, MA, 2004

Formation and Reactions of Metal-Containing Nanoparticles in Organic/Inorganic
Hybrid Aerogels,
Materials Research Society, Boston, MA, Nov. 30, 2004

Chemical Phenomena in Inorganic Aerogels That Comprise Ion-Containing Polymers,
Gordon Conference on Ion-Containing Polymers, Il Ciocco, Barga, Italy, May 2, 2005

Formation, Structure and Reactivity in Inorganic-Biopolymer Hybrid Aerogels,
Universita' Degli Studi Di Bari, Bari, Italia, May 5, 2005.

Electrochemical Modifications of Proton-conducting Membranes, Pacific Northwest
National Laboratory, Richland, WA, July 20, 2005

Formation and Structure of Polymer Silica Aerogels, Facolta di Scienze Matematiche, Fisiche e Naturali, Universita' Degli Studi Di Bari, Bari, Italia, June 6, 2006

Chemistry in Polymer Silica Aerogels, Facolta di Scienze Matematiche, Fisiche e Naturali, Universita' Degli Studi Di Bari, Bari, Italia, June 6, 2006

APPENDIX B

LIST OF MATERIALS CONSULTED

1. United States Patent No. 6,210,293 and its file history
2. United States Patent No. 6,503,156 and its file history
3. United States Patent No. 6,506,130 and its file history
4. United States Patent No. 6,595,873 and its file history
5. Acushnet's petitions for re-examination of the '293, '156, '130, and '873 patents and the exhibits thereto
6. Office Actions issued in the re-examination proceedings of the '293, '156, '130, and '873 patents and the exhibits thereto
7. Callaway's responses to the Office Actions issued in the re-examination proceedings of the '293, '156, '130, and '873 patents and the exhibits thereto
8. Acushnet's comments to Callaway's responses to the Office Actions issued in the re-examination proceedings of the '293, '156, '130, and '873 patents and the exhibits thereto
9. The expert report of Dr. Robert Statz
10. The expert report of Dr William MacKnight
11. The declarations of Davis Love III, Jerry Bellis, and William Morgan from the Acushnet-Bridgestone litigation
12. United States Patent No. 4,431,193
13. United States Patent No. 4,674,751
14. United States Patent No. 5,314,187
15. United States Patent No. 5,334,673
16. United States Patent No. 4,274,637
17. United States Patent No. 5,803,831 and its file history
18. United States Patent No. 6,152,836
19. United States Patent No. 6,905,648
20. United States Patent No. 5,885,172 and its file history
21. United States Patent No. 6,132,324 and its file history
22. United States Patent No. 6,749,789 and its file history
23. United States Patent No. 5,971,869
24. United States Patent No. 5,415,937
25. The depositions and exhibits of Tom Kennedy, Dennis Nesbit, Steve Ogg, Michael Sullivan, Shenshen Wu, and Mike Yagley
26. Golf Data Tech Sales Reports for Golf Balls sold at on and off course outlets from 1997 through 2004
27. "Great Leaps Forward", Golf Magazine
28. Callaway's proposed claim constructions as contained in a May 2, 2007 letter from Michael Amon
29. Acushnet's proposed claim constructions as contained in a May 2, 2007 letter from Clinton Brannon
30. ASTM Standard D 2240 – 91
31. ASTM Standard D 2240 – 95

- 32. ASTM Standard D 2240 – 02a
- 33. CW280202-280205
- 34. CW280214-280217
- 35. CW280327-280365
- 36. CW309061
- 37. CW320903-320911
- 38. CW325448-325450
- 39. CW329359-329362
- 40. CW334981-334984
- 41. CW366588
- 42. CW366590
- 43. CW366591
- 44. AC0117479

APPENDIX C

Proudfit '187 + Wu '673 versus '172 claim 1

<p>(1) A golf ball comprising a cover and a core, wherein said cover is disposed about the core and said cover comprises</p>	<p>Dr. Statz says that Proudfit '187 describes a golf ball comprising a core and a "cover" that is disposed about the core and that has inner and outer layers. (Statz ¶ 95.)</p>
<p>(a) an inner cover layer of a flexural modulus of at least about 65,000 psi; and</p>	<p>"Specific high modulus Surlyns which can be used in the inner layer include 8220 (sodium), 8240 (sodium), 9220 (zinc), and AD-8181 (lithium)." ('187 patent col. 6:16-18.) "The high modulus resins have a flexural modulus in the range of about 55,000 to about 100,000 psi." ('187 patent col. 6:1-3.)*</p>
<p>(b) an outer cover layer having a Shore D hardness of greater than 30 to 60,</p>	<p>Based on a golf ball Dr. MacKnight created for this litigation, Dr. Statz argues that the combination of Proudfit and Wu inherently discloses an outer cover layer having an on-the-ball Shore D hardness of 56.8. (Statz ¶ 106.)</p>
<p>having a thickness of less than 0.050 inches</p>	<p>Dr. Statz says that "Proudfit describes that the thickness of the outer cover layer can be from about 0.0450 to 0.0650 inches." (Statz ¶ 96.)</p>
<p>and comprising a thermoset material that includes at least one of a castable reactive liquid material and reaction products thereof.</p>	<p>Claim 7 of the '172 patent confirms that polyurethane is one type of "thermoset material that includes at least one of a castable reactive material and reaction products thereof." ('172 patent claim 7.) The '172 patent also admits that Wu '673 teaches a coating technique "which may be utilized to apply the castable reactive liquids employed in the present invention." ('172 patent col. 8:16-20.) Wu '673 claims a cover "made from a thermosetting polyurethane composition." ('673 patent claim 1.) Wu explains that "[p]olyurethane is the product of a reaction between a polyurethane prepolymer and a curing agent." ('673 patent col. 1:47-48.)</p>

* I note that U.S. Patent No. 5,415,937 confirms the flex modulus of three of these ionomers: Surlyn 8220 has a modulus of 79,000 psi; Surlyn 8240 has a modulus of 75,000 psi; and Surlyn AD-8181 has a modulus of 97,000 psi. (U.S. Pat. No. 5,415,937, table at col. 3:47-54.)

Proudfit '187 + Wu '673 versus '172 claim 7

7. The golf ball of claim 1, wherein the thermoset material comprises a material selected from the group consisting of a polyurethane, a urethane ionomer and a urethane epoxy.	See chart re claim 1. Wu '673 claims a cover "made from a thermosetting polyurethane composition." ('673 patent claim 1.)
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Proudfit '187 + Molitor '637 versus '172 claim 1

1. A golf ball comprising a cover and a core, wherein said cover is disposed about the core and said cover comprises	Dr. Statz says that Proudfit '187 describes a golf ball comprising a core and a "cover" that is disposed about the core and that has inner and outer layers. (Statz ¶ 95.)
(a) an inner cover layer of a flexural modulus of at least about 65,000 psi; and	"Specific high modulus Surlyns which can be used in the inner layer include 8220 (sodium), 8240 (sodium), 9220 (zinc), and AD-8181 (lithium)." ('187 patent col. 6:16-18.) "The high modulus resins have a flexural modulus in the range of about 55,000 to about 100,000 psi." ('187 patent col. 6:1-3; see also footnote on page D-2.)
(b) an outer cover layer having a Shore D hardness of greater than 30 to 60,	Based on a golf ball Dr. MacKnight created for this litigation, Dr. Statz argues that the combination of Proudfit and Molitor '637 inherently discloses an outer cover layer having an on-the-ball Shore D hardness of 59.4. (Statz ¶ 102.)
having a thickness of less than 0.050 inches	Dr. Statz says that "Proudfit describes that the thickness of the outer cover layer can be from about 0.0450 to 0.0650 inches." (Statz ¶ 96.)
and comprising a thermoset material that includes at least one of a castable reactive liquid material and reaction products thereof.	Claim 7 of the '172 patent confirms that polyurethane is one type of "thermoset material that includes at least one of a castable reactive material and reaction products thereof." ('172 patent claim 7.) The '637 patent discloses making a cover by "casting a liquid thermoset polyurethane foam ... around the center." ('637 patent col. 18:63-66.)

Proudfit '187 + Molitor '637 versus '172 claim 7

7. The golf ball of claim 1, wherein the thermoset material comprises a material selected from the group consisting of a polyurethane, a urethane ionomer and a urethane epoxy.	See chart re claim 1. The '637 patent discloses making a cover by "casting a liquid thermoset polyurethane foam ... around the center." ('637 patent col. 18:63-66.)
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